THE

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BRADFORD ELECTRICITY SUPPLY.

THE development of the Bradford Electricity Supply has received considerable attention from us on several occasions. In June of last year we put before our readers a clear description of what had been done at Bradford, and we took the trouble of showing what was intended to be carried out in the future. The local authorities have been at no end of trouble in endeavouring to make their system of supply as efficient and economical as possible, but their enthusiasm has halted occasionally, and they have pondered upon the direction in which they were tending. The display of a little anxiety when embarked upon a large scheme of electric lighting is excusable in anyone, but especially so in a local authority.

In lighting a small and fairly compact area near the generating station, the Corporation have been remarkably successful, both as regards efficiency of supply and economical working. They have been able to reduce gradually their price to consumers until they have brought it down to as low as 5d. per unit. Fresh demands, however, outside the present area were beginning to cause a little uneasiness in the minds of the Electric Lighting Committee, as to the best means of extending the supply. They were counselled by Mr. Shoolbred to extend the present two-wire system; on the other hand, Mr. Baynes, the resident engineer, recommended its conversion into the three-wire method, and backed up his recommendations with indisputable proofs of lower first cost and less expenditure on maintenance. Mr. Shoolbred, however, reconsidered his scheme, and finally brought before the Corporation a five-wire system scheme. The Committee, unable by themselves to form any definite opinion, called in Lord Kelvin to determine on the relative merits of Mr. Baynes's and Mr. Shoolbred's plans. Lord Kelvin, after careful consideration of the matter, concluded that the arrangements suggested by Mr. Baynes were most suitable for extending the supply; that of Mr. Shoolbred's being open to several serious objections. In addition to a written opinion, the Electricity Committee have had a long interview with Lord Kelvin on the question of the extension of electricity works, and it will be interesting to comment upon a few of the matters contained in the printed report of the interview. The Chairman of the Committee, at the outset of the proceedings, admitted that the present system of supply had been carried out contrary to the advice of Dr. John Hopkinson, who, when consulted by the Corporation, had urged the adoption of the three-wire system. It is difficult to see why the Committee thought it necessary to decline to act on the advice for which they were paying. We are much inclined to think that Dr. Hopkinson's recommendation was the soundest one under the circumstances, notwithstanding his known interest in the three-wires. Numerous questions, more or less irrelevant to the subject under consideration, were put to Lord Kelvin. Speaking of the extension, his Lordship is of

opinion that it can be carried out to some extent by the adoption of the three-wire system ; but after that they must lay down fresh plant in another generating station, not more than 1½ miles from the present station. With regard to the adoption of the three-wire system, the question that has, apparently, troubled the Corporation, is the amount of royalties they would have to pay to the patentees if they adopted it ; but, as his Lordship pointed out, it would be no very large amount. In the case of the third wire not being brought back to the station, he could not state how they would stand with regard to royalties. There have been various suggestions made as to how the Hopkinson patents can be evaded, such as earthing the middle wire, &c., but while it is doubtful how far these are real evasions, they are remedies which are decidedly inconvenient. We are tempted to differ from Lord Kelvin when he says that to have adopted the three-wire system when the supply was commenced would have been premature on account of the smallness of the demand. If our memory serves us right, the demand was fairly considerable soon after the station commenced work, sufficient at any rate to justify the adoption of the three-wire system, and although its initial expenses are heavier than the two-wire, there can surely be no question as to whether it is cheaper to adopt this system in the first place, or, at a later stage, to convert a two-wire into a three. As Lord Kelvin rightly says, all that is now known about the three-wire method was known when the building of the station commenced. In this respect it is interesting to note that the most successful electric light station, that of St. James, was opened about the same time as the one at Bradford, and we certainly consider that, among other things, the three-wire system was responsible for the extraordinary success of this company. It is, however, a most difficult matter to advise, with any degree of accuracy, on the best possible system of lighting for Bradford. It must remain a matter of uncertainty how far there will be a future demand for electric lighting. Bradford Borough, as we showed in the map published in our issue of June 10th, 1892, is about five miles by three, and if at any time there should arise a demand in any distant part of the borough for electric lighting, the town authorities may find themselves compelled to furnish a supply. Whether an unexpected demand such as this would be best supplied from a station in the vicinity is, of course, quite an open question. We do not condemn the present work when we say that had Bradford waited three or four years longer a very different system to the present one would have been adopted. The Committee took the opportunity of Lord Kelvin being amongst them to ask a few questions on matters about which they felt certain misgivings. It was asked whether the Willans type of engine was better than the Corliss type. In his Lordship's opinion the Willans, or a similar engine, was certainly preferable to Corliss, or a similar type of engine, which runs at slow speed with belt-driven or rope-driven dynamos. There has been always a certain amount of distrust of the Willans engine in Bradford ; indeed, it has always been a remarkable thing to us that Willans engines were ever introduced into a district where nothing but slow-speed engines were ever seen. One less versatile than Lord Kelvin would have been occasionally puzzled at the multiplicity of questions asked, such as the use of gas engines, the proper pressure to be observed in the boilers, dynamos, meters ; in fact, every part of the system of supply came before his Lordship. Although his advice was that it would be best, at present, to stick to the steam engine, he thought it might be advantageous to place a gas engine in the present station for use in case of emergency. Another matter of considerable importance was that of reducing the price of the supply during the day to 3d. or 4d. per unit for motive power. While there can be no question of the usefulness of a day load, it must not be forgotten that, according to the day load diagrams of the Bradford Corporation, the maximum output appears to be between the hours of four and five. It would be at this time that there would be the greatest demand for motive power, and to avoid overlapping of the lighting and power, and to overcome other difficulties, it would be necessary to have a large increase of generating plant ; in fact, the greater the demand for power purposes, the more will grow the necessity of having separate circuits.

ELECTRICITY AND THE SEWAGE PROBLEM.

WE owe the conception of the "germ" theory of diseases to Mons. Pasteur, who has clearly demonstrated the wonderful influence for evil of organisms so minute, as in some cases almost to defy the power of the microscope. No stronger evidence of its truth could be adduced than the fact that the antiseptic system of surgery with which the name of Lister is associated, and which is based on a recognition of the influence of germs, has done so much to diminish suffering and preserve life. Now that so many diseases have been traced to pathogenic organisms, especially to those which are present in water contaminated by sewage, the question of the vitality of these organisms and their germs has been rightly regarded as one of immense public importance, and the Royal Society, in conjunction with the London County Council, has instituted an investigation into it, which is being diligently prosecuted both from the botanical and the chemical point of view.

Sewage affords a rich *pabulum* for disease germs to develop upon, and attention has properly been directed to its purification. Chemists have hitherto had this problem almost entirely to themselves, and it must be admitted that the efforts to render the effluents from the drainage systems of our large municipalities as innocuous as possible have been, in many instances, crowned with a measure of success. Still, whatever may have been done, we are inclined to agree with Sir John Evans, K.C.B., F.R.S., &c., that there is much truth in that metrical abstract, perpetrated by a certain rhymer, of a paper read before the Royal Society :—

> Sewage, however disinfected,
> Is not from ill results protected ;
> Though made to all appearance pure,
> It still remains, not safe, but *sewer*.

And we submit that in the present state of our knowledge it is a disgrace that such vast accumulations of what were originally highly fertilising substances, should be discharged into the estuary of the Thames, and not only absolutely wasted, but converted into a perpetual nuisance, to be brought back at each tide within the limits of the metropolis from which they started.

We have said that hitherto the chemists have had the sewage problem almost entirely to themselves, but we must not overlook the practical application of electrolysis in the Salford experiments: of this system, or modifications of it, we are doubtless destined to hear more in the near future. Neither must the remarkable power of electric light in sterilising the germs of some micro-organisms be forgotten; though we are not aware that Prof. Marshall Ward, who demonstrated this, has yet made any practical applications of his observations.

It is quite time that electricians attacked the question of the safe disposal of sewage with more earnestness, and also the equally important question of the purification of the water supply. Indeed, it is difficult to consider these questions separately, for in each case the problem is the sterilisation of germs which are capable of spreading disease. In both fields the inventor has been busy: already there are dozens of patented systems in which electricity plays a more or less obscure part. Several of these have been put to the practical test, amongst them, an expensive system, whereby the water, as it left the reservoir, was subjected to the action of powerful alternating currents. Capital, however, is not usually forthcoming to support these experiments properly.

Amongst the latest application of electricity to sterilisation purposes is Mr. Albert E. Woolf's plan of producing huge quantities of a cheap disinfectant by electrolysing sea-water. An American contemporary speaks of it as an "electrical disinfectant," but this is no more than might have been expected, considering that the title of the article in which it is described betrays a complete misconception of the function of the process. We are disposed to accord to this process some consideration, in spite of its maladroit introduction, because of some favourable reports recently made by the officers of the Health Department of New York City, who have been unceasing in their efforts to improve the sanitary conditions of that rather unsanitary place.

Twenty miles from New York there is a little town called Brewsters, where the sewage drains into a marsh, and constitutes a nuisance and a menace to the health of the inhabitants. Here Dr. Cyrus Edson, chief of the medical staff of the New York Board of Health, determined to test Mr. Woolf's method of purification. The plant, which has been in operation for some time, consists of boilers and a 15 H.P. steam engine, operating a Zucker and Leavitt dynamo, capable of furnishing 700 ampères at 5 volts. Close to the dynamo is an electrolysing tank, which has a capacity of 1,000 gallons, and is fed from above by a 3,000-gallon storage tank containing the sea-water. Three copper plates, coated with platinum, constitute the positive electrodes, whilst the negative electrodes are represented by four carbon plates placed alternately, each being of dimensions 1 by 12 by 12 inches.

When the current passes, the chlorides, bromides, &c., which give sea-water its character, are converted into hypochlorites, hypobromites, &c., and in this condition are capable of decomposing and rendering harmless any organic matter with which they come in contact. The electrolysed sea-water is passed directly into the sewers, and its effect is so marked that the effluents are free from offensive odour, and are, in short, robbed of their dangerous properties. The theory is that part of the chlorine in the hypochlorite replaces a part of the hydrogen in the organic matter, whilst another portion unites with the liberated hydrogen; and that ozone is produced which in its turn exercises a favourable influence. In other words, the organic matter, be it organised as in the lower forms of life (viz., bacteria, &c.), or non-organised, as in the solid or suspended matter of sewage, is decomposed and permanently disinfected.

The estimated cost of the electrolysed sea-water is only 10 cents. per 1,000 gallons, or, expressed in other terms, 140 gallons of it will cost as much as one gallon of a 1 per cent. solution of chloride of lime. Comparing the cost with that of bichloride of mercury, the disproportion is in the ratio of 100 : 1 in favour of the sea-water solution; while a 5 per cent. solution of carbolic acid costs from two to three hundred times as much.

The experiments made thus far have been so successful that Dr. Edson has recommended that steps be taken to locate a disinfecting plant in New York City, and we understand that this recommendation will soon be acted upon. Thus we have a new and interesting illustration of the cosmopolitan capacity of applied electricity.

The "Hall Effect."

A SHORT time ago we noticed some researches originated by Kundt on the nature of the "Hall effect" in extremely thin sheets of metal, obtained by electrolytic deposition on platinoid glass. He stated that in the three metals examined, viz., iron, nickel, and cobalt, he found that the "Hall effect" is proportional to the rotation of the plane of polarisation of light in these metals in a magnetic field. Kundt has followed up these results in the *Annalen der Physik und Chemie*, No. 6, 1893, pp. 257—271, with a paper in which he argues that since the rotation of the plane of polarisation in these metals is proportional to the magnetising force, therefore the "Hall effect" is also proportional to the magnetising force. He further states, as a somewhat remarkable fact, that whilst cast bismuth shows the "Hall effect" to a considerable degree, the effect is very weak indeed in bismuth that has been obtained by electrolytic deposition.

The Measurement of Electrical Resistance.

THERE is an important paper in the *Annalen der Physik und Chemie*, No. 6, 1893, pp. 225—256, by F. Kohlrausch, in which he discusses the limits of the method of determining electrical resistances by means of alternating currents, which owes its elaboration to him. Other observers have somewhat severely criticised the method of the alternating current and telephone as applied to liquid resistances, and in this paper, Kohlrausch carefully examines the errors involved, discussing the results already obtained in the light of these criticisms. In cases of high resistance, *e.g.*, 100,000 ohms, two of his critics, MM. Bouty and Foussereau, entirely failed to obtain consistent results; these, he says, may be secured by introducing suitable modifications into his method, such as placing the induction coil at a sufficient distance from the bridge, directing its axis perpendicular to that of the rheostat, and placing the telephone perpendicular to the direction of the lines of force of the induction coil. By taking such precautions very high fluid resistances can, he says, be successfully measured with the greatest precision. He shows how the introduction of small condensers of adjustable capacity can, in certain cases, increase the accuracy of the measurements, *e.g.*, in the case of water and very dilute solutions the electro-static capacity of the containing cell is a source of disturbance, and this may be obliterated by the introduction of such a condenser. In conclusion, Kohlrausch discusses the want of symmetry of the telephone which is employed on the Wheatstone Bridge.

ARC LIGHTING.

BY E. TREMLETT CARTER.

(*Continued from page* 118).

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IX.

IN the Brush-Geipel regulator, which is an important modified form of the carbon regulator due to Brush, a relay is employed to close the circuit of the electro-magnet and carbon resistance. This renders the apparatus sufficiently sensitive as to regulation, with a much smaller range of current. The latest pattern is illustrated in fig. 22, which shows the regulating resistance and electro-magnet on the left, and the relay attachment on the right.

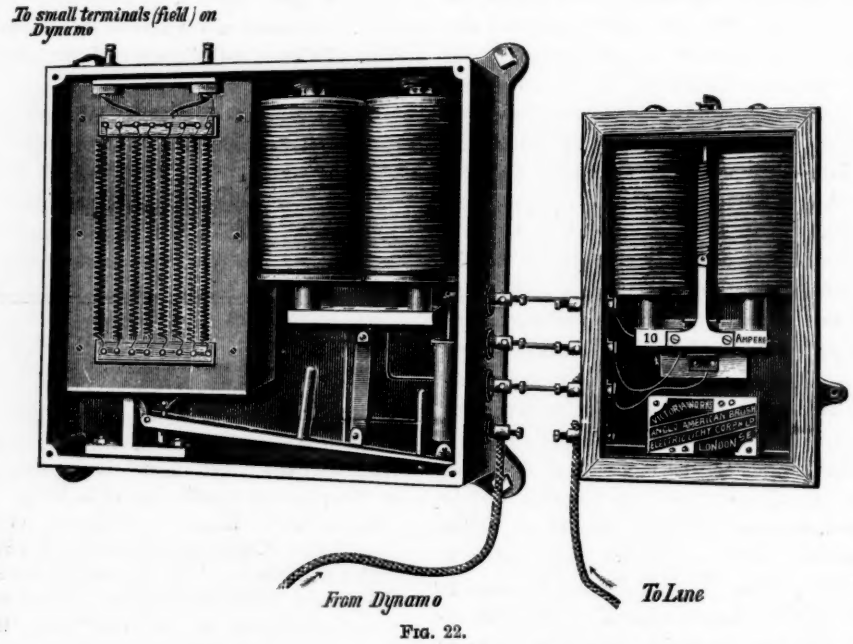


FIG. 22.

The Brush regulator stands in relation to some other of the important regulators in this class, somewhat as an ordinary pendulum governor stands to those governors which are fitted with supplementary gearing; for, while it has to exert of itself the force required to produce regulation, they have only to exert a small force sufficient to bring some mechanical device into action upon the shunt circuit. One of the most interesting examples of this latter class of regulator is that invented by Goolden. It is represented by fig. 23. The main circuit solenoid attracts an iron core against an elastic resistance supplied by a spring. Fixed to the core, there is a pair of crown wheels, keyed on a vertical spindle. The two wheels gear into two screw-threads, which are so arranged that when, by the position of the crown wheels, either one is in gear the other one is, for the time being, out of gear. The two screws are kept in constant revolution by means of a small strap and pulley, and their motions are such that a reversing motion is communicated to the spindle, turning it in one direction when the solenoid carries a strong current, turning it the other way when the current is weak. Upon the vertical spindle there is a thread cut, and this thread carries a long nut to which a sliding contact is attached. According to the motion of the spindle, so the slider will be raised or lowered, and will increase or decrease the resistance of the shunt by cutting in or out some of the coils in the rheostat connected with the bundle of wires at the bottom of the figure. The variation of current lies always between that which will bring the top wheel into gear with the screw, and that which will bring the bottom one into gear, and may be made small by having small teeth on the wheels and by placing the screws as near together as possible. If there is much friction in the working parts the range of current will be greater than this; so that all the parts should have as easy motions as may be consistent with their other actions. Regulators invented by Henrion, Maquaire, and others, may be included in this class; but they do not involve points that would be of any further interest to the present inquiry. The object in designing all such appliances should primarily be to make the variation of working current as small as possible; and, secondarily, to produce a regulator which shall be prompt in action, simple and cheap in construction, and wasteful of as little power as possible.

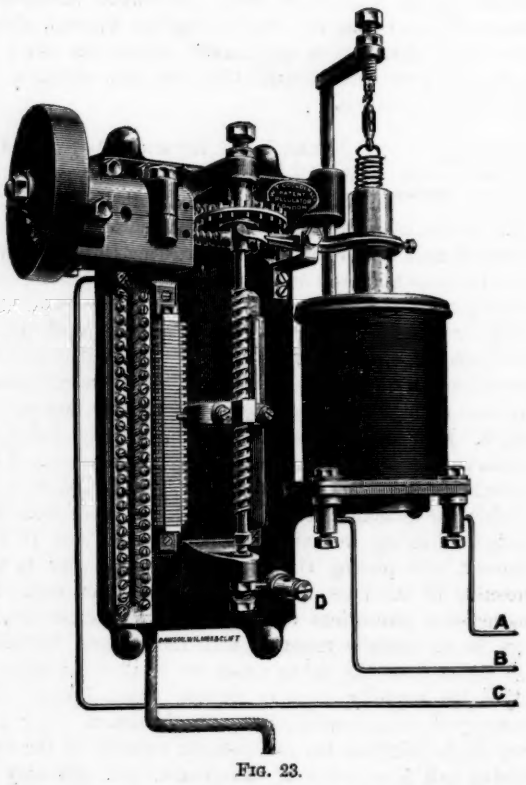


FIG. 23.

(*d*). *By Means of a Pilot Brush on the Commutator.*—It is well known that when the current in the dynamo armature increases, the reaction upon the main field causes a distortion of that field and a consequent shifting of the distribution of potential on the commutator bars. This fact has been made use of in the "third brush" regulator by

Waterhouse. Fig. 24 gives the arrangement of the circuit. The ordinary brushes, A and B, are adjusted at the proper lead for the required current: and a third brush, C, is set at a small angle in advance of the positive brush, A. Current is taken from both these positive brushes, that from A going through the field coils to a resistance, R, and that from C going straight to the other end of the resistance, R. By means of a slide contact, S, the total current is taken off to the lamps at some point in the resistance, R; this point being

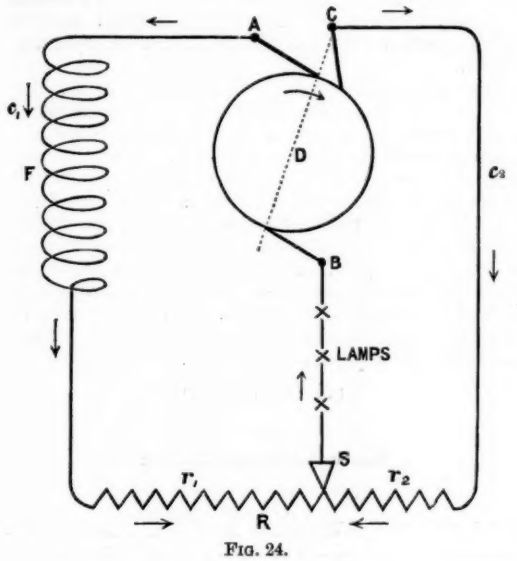


FIG. 24.

adjustable for the purpose of varying the proportion between the field current, c_1, and the shunted current, c_2. The total current returns from the lamps to the brush, B. When the slide has been set so as to give the right current at the right speed, the machine may be run and the third brush will regulate for practically constant current. For, if by any chance the current in the armature should be increased, the extra armature reaction would shift the point of maximum potential from A towards B, thus sending less current through the field and more through the shunt, thereby causing the induction in the field and the E.M.F. to drop, until the normal current is again passing. The adjustment, S, is only constant when the speed is constant, so that it might be found convenient to fix the sliding contact to an electrical or centrifugal governor, in order to maintain constant current at variable speeds. The author does not know if this modification of the method has been adopted. In some other devices for regulating the exciting current by means of a pilot brush, the third brush is automatically moved over the commutator, drawing off a current which is employed to partially demagnetise the field magnets. When the armature current increases, this third brush readjusts itself, so as to increase the demagnetisation of the field.

(*e*). *By Shifting the Ordinary Brushes on the Commutator.*—Inasmuch as the distribution of potential round the commutator of a dynamo is not uniform, it will be possible to select a number of pairs of points of contact for the brushes, each one of which will give a different voltage on the circuit. It will be only necessary to attach the brush rocker to a system of levers or other gear, operating this gear by the current in the main circuit, in order to regulate the voltage and the position of the brushes to give constant current over a wide range of load. This method of regulation has been successfully applied to several well-known dynamos; but, as the details of the method and the difficulties which its adoption calls into existence are specially connected with dynamo design, and not with auxiliary appliances, we shall defer consideration of them till we come to the study of the actual dynamos in which the method is employed.

These five methods constitute the practicable means of regulating a dynamo to give constant current to a main circuit which imposes a variable load. Of the other means which have been suggested—the insertion of a resistance into the main circuit, or the opposition of some adjustable external E.M.F.—it may be said briefly that they are wasteful and inconvenient, the former being directly wasteful of power, and the latter inconvenient and indirectly wasteful, on account of its low efficiency. We are now prepared to follow the design of dynamos for series lighting with arc lamps, having seen that it is by no means necessary that they should be compound-wound in order to be successful machines; and we shall, of course, expect to find differences in design, according to the particular mode of regulation which is adopted with the dynamo.

Besides the mode of regulation, there is another vital point which affects the character of the dynamo design for series work; it is the maximum voltage of the machine. This specially affects the armature winding, as to whether the armature coils shall be "open" or "closed." Some discussion of this point will, therefore, be necessary at this stage in our study. Closed coil armatures are those in which the conductors form a continuous circuit round the armature core, and in which each section is either closed on itself (as it passes under the brush), or is included in the circuit of the main current. No single conductor or part of a conductor is there but what is included at all times in some one or other closed circuits, and none in which there can be an E.M.F. without there being a current. The ordinary Gramme winding is an example of closed coil winding, and is too well known to need description here. In all the various forms of open coil winding each armature coil is, at some time of each revolution, cut out of circuit, and is not short-circuited on itself during this time; it is an open circuit for the time being, and no current can pass along it till it is cut in again. This will be evident from a study of fig. 25,

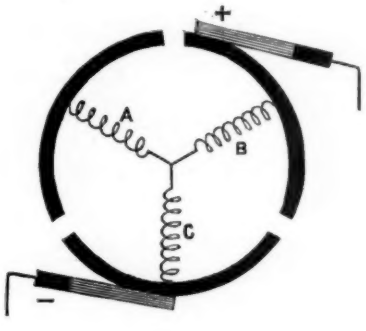


FIG. 25.

where an open-coiled armature is shown; the coil, A, for example, is on open circuit, while B and C are included in the main circuit.

Whichever method of winding is adopted, the conductors on the armature will be required to develop a very high E.M.F., and this E.M.F. may be made up of a lot of small E.M.Fs. in a great number of armature sections, or of larger E.M.Fs. in fewer sections. Either plan involves great difficulties in the closed-coil winding; but the latter is admirably adapted to open-coil winding. If a closed-coil armature is made up of only a few sections, so as to minimise the bars on the commutator, each section will have a high coefficient of self-induction. The result will be bad sparking at the brushes. For, in the commutation of any one section, that section must be short-circuited under the brush in a forward part of the field of such intensity that the induced E.M.F. in the section will just reverse the current in it. This is not difficult, and takes but a small field, when the section consists of few turns and has a low E.M.F. of self-induction. But where there are numerous turns in the section, the brushes must be set at a very large angle of lead indeed, so as to put the section into a strong field during commutation; and this is wasteful even wherever it is not impossible. But it is not always possible, for there is of necessity a large armature reaction in certain forms of arc light machines; and when this is the case, the brushes would require to be shifted right into the centre of the pole arc before sparking would cease, if there were very many turns on each section. The wastefulness of the practice consists in the large number of back-turns and cross-turns which it involves. Clearly, then, we

cannot increase the E.M.F. of a closed-coil armature by keeping the number of sections constant and increasing the turns on each section; we must rather reverse the process, and keep the number of turns on each section nearly constant, having more and more sections as the E.M.F. is to be raised. But here, again, we meet with difficulties; for, by this practice, the number of strips on the commutator will be increased, and the space between the strips will have to be too small for the high E.M.Fs. which are induced. Flashing across the commutator strips results, and it is difficult, if not impossible, to keep a good working surface on the commutator. Beyond about 1,000 volts it is found, in general, to be impracticable to work a closed-coil armature; for either there will be a wastefully large lead, or there will be vicious sparking under the brushes, or the current will flash from strip to strip and will destroy the commutator. Increasing the diameter of the commutator is, of course, one means of staving off the difficulties; but they are only scotched, not killed, and very soon the limiting size of diameter is attained, and with it the limiting voltage at which this class of machine may be successfully worked.

According to Mr. Esson (*Journal* Inst.E.E., Vol. xix., p. 162), Messrs. Paterson & Cooper have succeeded in running Gramme-wound machines for constant current at from 800 to 1,500 volts; and Schückert and Immisch dynamos are run at 1,000 volts. But it seems more than probable that machines of this type will not stand any serious alteration of load if worked at higher voltage, owing to the great range of lead which would be required, and the consequent sparking and flashing over. "Experience," says Dr. S. P. Thompson, "is in the main against the use of armatures of this type;" and it is significant that more than three-quarters of the arc lighting of the world is done by open coil dynamos.

Open-coil winding renders quite admissible the practice of putting a large number of turns on each section of the armature and having few sections. For here it is not requisite that the commutation should take place in a field which will oppose the self-induction of the coil, or which would be required to reverse the current in it. The operation of commutation may be explained by reference to fig. 26.

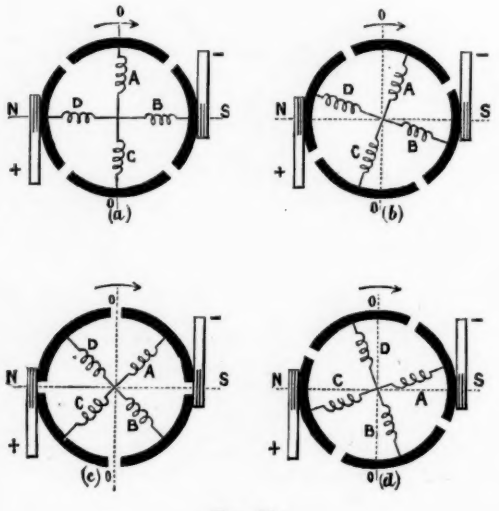


FIG. 26.

In the position (*a*), the four armature coils A, B, C and D, are arranged so that the pair, A and C, are in the position of zero action, *o*, *o*, and are not in circuit, while the pair, B and D, are in the position of maximum action, parallel with the magnetic lines, N, S, and are in circuit with the brushes. A moment later, when the position (*b*) is reached, the E.M.F. in the active pair has fallen, while that in the cut-out pair has risen from zero to a considerable value. Still, however, the E.M.F. in the active pair is much larger than in the inactive. At the next instant, when the position (*c*) is attained, all the coils are at 45° to the lines of the resultant fields, and, since they have the same velocity, the E.M.Fs. in both pairs will now be equal. Their E.M.Fs. may be combined in parallel, by making both pairs touch the brushes at the same time, as is seen to be the case here. Since the E.M.F. in the pair, A, C, is increasing while that in the pair, B, D, is decreasing, the effect of permitting them to remain long in parallel would be to cause the pair, A, C, to send a backward current through B, D. In the actual arrangement, before this can happen the brushes have glided off the commutator strips of the declining pair, B, D, and have cut those coils from the circuit. By properly arranging the period of combined contact at the brushes, disconnecting each pair when the tendency to reversal of current in it is about to set in, the minimum of sparking is obtained.

In the example of open-coil winding given in fig. 26, each pair of coils is cut-out for almost half of every revolution; but the period of idleness is diminished in some of the modern open-coil arc lighting machines. It will, of course, be seen that economy of design would lead one to endeavour to minimise the period of inactivity; for in proportion to the length of this period, the more will be the weight of copper that must be put on the armature for any given output at any given speed. Idleness of working details, when the idleness involves the use of a substitute, always reduces the *plant efficiency* of any machine. This is very fully dealt with in the descriptions of the Brush and Thomson-Houston dynamos in a later part of this section.

(*To be continued.*)

THE JURY OF AWARDS FORMULATE A FEW TESTS FOR DIRECT COUPLED AND OTHER DYNAMOS.*

THE jury appointed in the electricity class of the World's Fair have begun to formulate rules to guide them and simplify matters in the awarding of the medals.

It is proposed to test a number of the larger direct-coupled dynamos for the purpose of ascertaining the consumption of steam and the electrical and commercial efficiencies of the apparatus under various loads. Tests of smaller apparatus of this kind may be decided upon later, but arrangements for the same are not yet completed.

Tests will be made for the purpose of helping the jury to form an estimate of the value of the exhibits. Where the jury are able to come to a conclusion without carrying out such tests they may grant awards based on an examination of the exhibits. It will only be practicable, in relation to the particular exhibits referred to herein, to test such representative apparatus as is located favourably in relation to steam supply, and can be operated under a desirable load. It is, therefore, to be understood that the awards on the apparatus for which tests are herein provided are to be "granted upon specific points of excellence of advancement," the same as other exhibits, but that an abstract of the general results of the tests will be added to the report for an award, with references to the detailed reports on the subject.

There are to be three classes of tests of each apparatus, to be designated A, B and C. They are:

"A" tests: Not less than one or more than three complete tests are to be made with each apparatus to ascertain the economy in the use of steam and the relation of the indicated horse-power to the electrical output. One of such tests to be made with a load corresponding substantially with the maximum efficiency, one near the minimum allowable load, and one near the maximum allowable load.

"B" tests: Partial tests, supplementary to the above, without measuring the water evaporated, but varying the load by gradual increments through the practicable range; to be made for comparing the indicated horse-power with the electrical output.

"C" tests: These tests are designed to aid in distributing the energy developed in the engine in excess of that shown

* New York *Electrical Review*.

by the total output in watts, to include friction tests of engine and a determination of the resistance caused by exciting the field with the main circuit open; they include also tests of electrical resistance, heating of armature, field, &c.

The order of tests provides that the apparatus shall be first operated at six-tenths of its maximum load for at least four hours before commencing the tests. The first complete or "A" test is then to be made, to be followed by the minimum "A" test, and that followed by the maximum "A" test. In case all of these tests cannot be made in succession, the rule as to operating the dynamo four hours at six-tenths load is to be followed previous to each test. The same preliminary run to be made also before commencing the "B" tests.

ERECTION OF TRAMWAY CONDUCTORS.

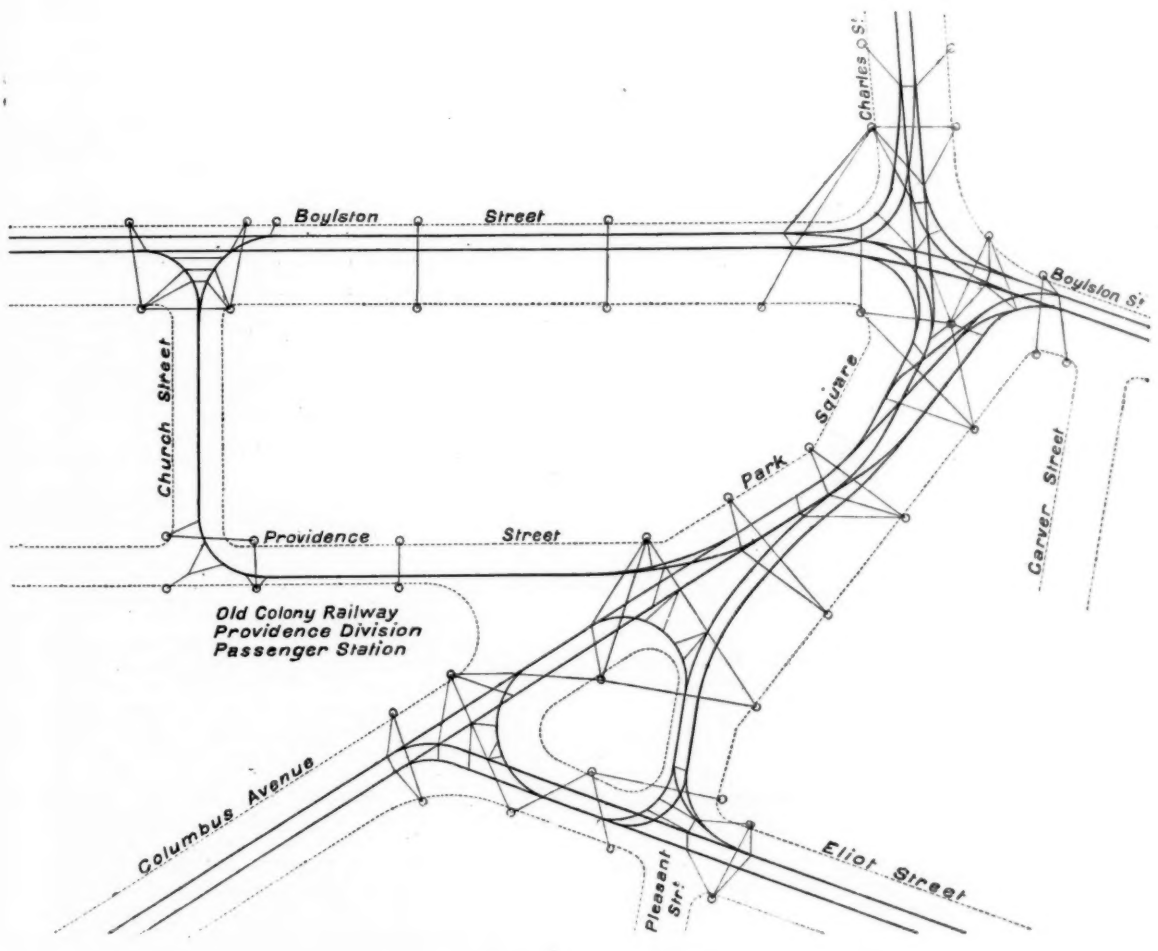
IN the installation of an electric tramway equipment, the lineman plays a most important part. Not only must the conductor be sustained at a uniform height, with a minimum of sag, and as nearly as possible at the same relative position to the metals, but the appearance of the finished work must be kept constantly in mind, lest the line be unsightly and invite unfavourable criticism.

Each new line presents new conditions of crossings, turnouts, switches, and sidings, and to these must be added the ever-present necessity for properly locating points of anchorage, feeder connections, sectional breaks, and joints in the conductor itself. To accomplish the desired result, the constructor must lay out his work with the greatest care, and with a practical appreciation of the many ingenious special appliances which have been developed to economise labour and to give the maximum of strength and stability, with a minimum of aerial material.

As an illustration of the difficulties to be met with, the accompanying plan of a congested section of the electric line of the West End Street Railway Company of Boston, U.S.A., is worthy of more than a passing notice. Along the lines shown, the company's cars follow each other as closely as possible, being never more than 30 seconds apart during the business hours of the day.

It will, of course, be understood that in making this plan, it has been necessary to exaggerate the relative size of the wires. The whole web is scarcely noticeable from the street itself.

The "West End" Company is one of the most progressive and important of the American tramway companies. The commercial success of electrical traction in the United States, practically dates from the day when the shareholders of that company unanimously voted that their interests would be best furthered by the adoption of electricity as a motive power for all their lines, strengthening their expression of opinion by empowering their directors to expend £800,000 in making the change from horses. Since that time, now about four years ago, the company has steadily increased its electrical equipment, until there are at present about 140 miles of electric tram lines in the City of Boston and stretching out to its suburbs. We have already referred to the new power station erected by the company, which increased the "West End" supply of tractive power to a grand total of considerably more than 60,000 H.P.



Boston is probably the most conservative city in the United States, and that it should be so far ahead in the adoption of electrical motive power, speaks volumes for the efficiency of the motor and for the convenience that has resulted to the public from the introduction of the trolley car.

O

THE EXTRACTION OF ANTIMONY BY ELECTRICAL METHODS

THE extraction of antimony from its ores is invariably performed by dry methods which are strictly metallurgical, but, judging from the trend of the proposals which have been made during the last 20 years, and the increased facilities which attend the application of electricity in electrolytic operations, it seems likely that the old methods will shortly disappear. Although effective they were extremely wasteful, and that is of itself a matter for serious consideration, since antimony is not a very widely nor very plentifully distributed element.

C. A. Hering has recently passed in review the various wet methods of extracting antimony which have so far been proposed. Of these he considers that eight come within the range of practical application, and they may be briefly described as follows :—

1. *R. F. Smith's Method.*—The finely powdered antimony ore is dissolved in hydrochloric acid and the metal precipitated by zinc or iron and afterwards melted. Objection : The process is accompanied by poisonous fumes. (*Vide* Eng. Pat. No. 205, January 26th, 1871 ; also *Berichte*, 1871 [15]).

2. *Hering's Method.*—The ore is powdered and dissolved in hydrochloric acid and precipitated either an algaroth powdered by dilution with water ; or as metal by means of zinc, iron, &c., or the electric current ; or as a sulphide by means of sulphuretted hydrogen. Objection : The same as above. (*Vide Dingler's Polytechnisches Journal*, 1878, pp. 230 and 253.)

3. *The Hargreaves-Robinson Method.*—The same as 1 and 2. (*Vide* Eng. Pat. No. 1,584, 1881.)

4. *F. M. Lyte's Method.*—The one is roasted with salt at such a temperature that antimony chloride is formed and volatilises. The latter is condensed by means of a solution of common salt, and the metal precipitated from the solution by means of iron or zinc. This method is chiefly designed for the treatment of lead, silver and copper ores containing antimony. Objection : chlorine gas escapes into the air, and this, together with the complex apparatus necessary, makes the process costly. (*Vide* Ger. Pat. No. 22,131, 1883.)

5. *The Simpson-Parnell Method.*—The powdered ore is extracted with solutions of alkaline or alkaline earthy sulphides. Antimony sulphide is precipitated by means of hydrochloric acid. Objection : Suitable only for rich ores ; gases evolved objectionable. (*Vide* Ger. Pat. No. 30, 1884, also Warwick's Eng. Pat. No. 8,415, May 15th, 1891, wherein the metal may be recovered electrolytically.)

6. *Borcher's Method.*—The ore is extracted with sodium sulphide, and the solution thus obtained is electrolysed, metallic antimony being deposited at the cathode. Three per cent. of common salt is added to increase the conductivity and precipitate any iron sulphide that may be formed. A current density of 40—50 ampères is used for each square metre of electrode requiring an E.M.F. of 2—2·5 volts. The metal is separated in a more or less compact state, according to the current used, but to make it marketable it must be fused. (*Vide Chemiker Zeitung*, 1887, p. 1,021.)

7. *Sanderson's Method.*—Specially devised for treating the crude antimony of Lixo, Oporto, which contains gold. An electric current is passed between plates of the crude metal immersed in a solution of antimony chloride and common salt. The gold falls to the bottom, whilst the antimony is transferred from one electrode to the other. Objection : too costly for technical use. (*Vide* Ger. Pat. 54,219, 1890.)

8. *Kopp's Method.*—The ore is dissolved in a solution of ferric chloride containing some common salt and hydrochloric acid. The filtered liquid is electrolysed, with the result that antimony is separated at the negative electrode, whilst the ferrous chloride which exists in the solution is oxidised to ferric chloride at the positive electrode. The electrodes are of lead. The liquor is heated to 50° C. and kept in circulation. The most compact metal is obtained with a current of 50 ampères per square metre of cathode. This process appears to be profitable, and it presents the advantage of evolving no noxious fumes. (Ger. Pat., June 28th, 1892.)

A patent has also been obtained by Siemens & Halske for the electrolytic separation of antimony ; this, however, is only alluded to in a note.

In these eight methods it is interesting to notice the gradual development of the electrolytic principle. Kopp's process, which is, we believe, the one most recently brought out, is a typical electrolytic operation, and Hering has nothing but good to say of it.

Further details of these processes may be found by consulting the references already given, and Hering's paper itself may be read in *Dingler's Polytechnisches Journal* 286, page 287.

RESEARCHES ON THE FORMATION OF OZONE.

AN important contribution to our knowledge of ozone has recently been communicated to the Chemical Society by W. A. Shenstone and Martin Priest. They submitted a known volume of oxygen confined in an ozone generator of the Brodie pattern to the influence of discharges produced under varying conditions of potential, and determined the amount of ozone produced by observing the change of volume by a mercury manometer. The discharge was supplied in some cases from an induction coil, in others from an influence machine. There was nothing specially novel in the electrical means used, but the conclusions drawn from the results of the experiments are particularly interesting, and may be epitomised as follows :—

1. It is possible to obtain fairly concordant results.

2. Provided that the path of the discharge be not too short at any point in the generator, the maximum proportion of ozone that can be produced at a given temperature and pressure is nearly independent of the difference of potential employed, provided that this be between the limits of 33 and 69 C.G.S. electrostatic units.

3. If the path of the discharge be very short at any point in the generator, the maximum proportion of ozone that can be obtained has an inverse relation to the differences of potential employed.

4. The rapidity with which oxygen is converted into ozone in a given ozone generator, and under given conditions of temperature and pressure, is greater when great than when small differences of potential are employed, or, in other words, a given percentage of ozone can be obtained more quickly by employing a high difference of potential than by means of a lower one.

5. The maximum proportion of ozone that is obtained in a given generator, at given temperature and pressure, is less when the number of discharges in unit of time is very great, than when it is more moderate.

6. The highest proportion of ozone can be obtained (at given temperature and pressure, and if a given difference of potential be employed) by using a generator made of very thin glass, and in which the inner tube fits into the outer tube rather closely ; but such a generator acts slowly if the mingling of its contents depend upon diffusion.

7. A greater proportion of oxygen can be converted into ozone in a given generator by means of a given difference of potential, the gas being maintained at a given temperature and pressure by the action of an induction coil, than by means of a "Wimshurst" or "Voss" machine.

Messrs. Shenstone and Priest conclude from their general results that the silent discharge acts by decomposing oxygen molecules into their atoms, which subsequently recombine, to a greater or less extent (according to the temperature and pressure), to form the triatomic molecules of ozone, and that ozone is not formed by the direct action of the discharge.

In the discussion which followed the reading of this paper, Prof. McLeod drew attention to the possibility of producing ozone in considerable quantity by subjecting oxygen under pressure to the influence of the discharge in a tube, one end of which was at a low temperature ; and to the unfortunate tendency which liquid ozone had to explode—a fact which he regarded as a barrier to the successful application of the liquefied gas. Prof. Ramsay criticised the authors for having paid attention only to the influences of difference of potential, and for not taking into account what was probably of more importance, viz., the quantity of electricity in the dis-

charge. In this criticism Mr. Crookes concurred, and said that perhaps the difference observed in the case of the coil and the influence machine might be ascribable to this, as the coil would afford a larger quantity of electricity; and that a rapid discharge would afford a smaller quantity than a slow one. He then referred to the difficulty he had frequently experienced in causing a discharge to pass in "Tesla" tubes; a tube through which no discharge would pass during several minutes would suddenly become luminous, but only when charged dangerously near the heating point.

The President, Dr. Armstrong, referred to the view held by Prof. J. J. Thomson, viz., that the electric discharge in gases was of the nature of chemical action. He was not satisfied with the evidence that only oxygen was concerned in the production of ozone, and was of opinion that it would eventually have to be admitted that the formation of ozone was the outcome of an electrolytic charge, in which probably conducting moisture was concerned.

We believe that the authors are continuing their investigation of ozone, this being their second contribution, and we look forward to the elucidation of many other points of doubt besides those expressed in the discussion.

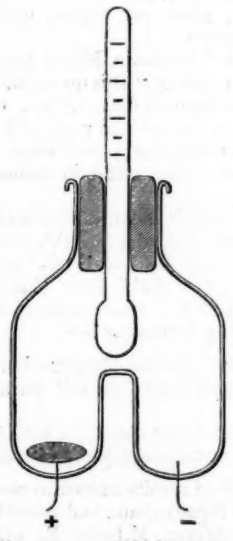
CLARK'S STANDARD CELLS.*

By Dr. K. KAHLE, of Charlottenburg.

THE subjoined instructions for the production of Clark's elements are compiled on the basis of experiments made at the "Physico-technical Imperial Institute,"† and are intended for the use both of investigators who require a standard for the tensions used in their researches, and especially for workshops which often have to furnish such elements for technical purposes.

Definition and Properties of the Element.—The element contains, as a positive electrode, mercury, and, as a negative electrode, amalgamated zinc. The electrolytes are a concentrated solution of zinc sulphate and mercurous sulphate. Its electromotive force is 1·438 volts at 15°, and decreases between 10° and 25° by a mean of 0·00115 volt for every additional 1° of temperature.

Production of the Element.—The vessel of the element, as shown in the accompanying figure, consists of two vertical



limbs closed below and united above to a common neck capable of being closed by a ground glass stopper. The diameter of the two limbs must be at least two centimetres, and the length at least three centimetres. The neck of the vessel must have a diameter of at least 1·5 centimetres, and a length of at least 2 centimetres. Platinum wires of about 0·4 millimetre are fused into the bottom of each limb.

The vessel is filled in a different manner, according as it is to be used at the place where it is made, or has to be sent away.

In the former case, pure mercury is poured into one of the limbs, and into the other an amalgam, liquid when hot, and congealing when cold; it consists of 90 parts of mercury and 10 parts of zinc. The platinum wires at the bottom of the two limbs must be completely covered with mercury or with the amalgam. Upon the mercury is placed, to the depth of 1 centimetre, a paste, formed by rubbing together mercurous sulphate and mercury with a liquid consisting of crystals of zinc sulphate, and a concentrated solution of zinc sulphate. Both this paste and the zinc amalgam are then covered with a stratum of crystals of zinc sulphate about 1 centimetre in depth, and the entire vessel is then filled with a concentrated solution of zinc sulphate, so that the glass stopper when inserted exactly touches the liquid. Care must, however, be taken that the vessel contains a small bubble of air to prevent bursting on a considerable rise of temperature. When the vessel is finally closed, it is coated on its upper margin, before the insertion of the stopper, with an alcoholic solution of shellac.

If the element has to be sent away, there is inserted in place of the mercury a circular plate of platinum, electrolytically amalgamated, about 1 centimetre in diameter and 0·1 millimetre in thickness, firmly riveted to the platinum wire introduced through one of the limbs. The zinc amalgam forms, as above, the negative electrode, and it is covered with a stratum of crystals of zinc sulphate.

The remaining space of the vessel is filled with the paste of mercurous sulphate, so that the stopper when inserted just touches the paste. The ultimate closure of the vessel is effected as above described.

Preparation of the Materials used in the Element—Mercury.—All the mercury used in the element must be submitted to the known purifying process and distilled in a vacuum.

Zinc.—The zinc known in commerce as "chemically pure," may be used without any further treatment.

For obtaining the amalgam, we add to 9 parts by weight of mercury 1 part by weight of zinc, and heat the mixture to 100° in a porcelain dish, with moderate stirring, until the zinc is dissolved in the mercury.

Zinc Sulphate.—The sulphate of commerce, before use, is tested for acid with tincture of litmus, and for iron with potassium sulphocyanide. If sufficiently pure, it is re-crystallised as directed below. If it contains perceptible traces of free acid, equal parts of the sulphate and of distilled water are boiled with zinc filings, in a suitable porcelain vessel, until no further escape of gas is perceptible, and the solution, on cooling, deposits a white, or if iron is present, a brownish, precipitate. If the solution is free from iron, it may be filtered, after standing for two days. Otherwise, it is again heated to 60°—80°, and electrolysed for six hours with a current not exceeding 0·2 ampère, introduced by means of two pieces of sheet platinum of 50 square centimetres, suspended in the liquid. After the liquid has cooled over night, we must again ascertain by means of tincture of litmus that no free acid has been formed during the electrolysis. If this is the case, the boiling with zinc filings is repeated, and the solution is again electrolysed with a feebler current. During this entire treatment, the concentration of the liquid must be kept approximately constant. Hence it is well to keep the vessel covered with a glass plate, so that but little watery vapour may escape. When the solution is sufficiently free from acid and iron, it is filtered. To every litre of the filtrate are now added about 50 grammes of mercurous sulphate (free from acid), and it is well stirred up. On prolonged standing, the salt of mercury generally turns yellow. After the solution has stood for a day, if a portion of it on shaking up with freshly added mercurous sulphate produces no further yellow colouration even on standing for some hours, the solution is filtered and then concentrated in a shallow porcelain dish on the water-bath. The crystals must not be formed at too high a temperature, as they otherwise lose a part of their water of crystallisation. After the heating is stopped, the dish is covered with a glass plate and allowed to remain on the water-bath. If no crystals appear after cooling,

* *Zeitschrift für Instrumentenkunde.*

† See ELECTRICAL REVIEW, August 26th, 1892, p. 270, and September 9th, p. 322.

the evaporation must be repeated. The crystals must be kept in a closed vessel.

Mercurous Sulphate.—The mercurous salt employed must not be coloured yellowish by a basic salt. If this is the case, 1 part by weight of the salt is mixed with 2 parts by weight of distilled water, and, whilst constantly stirring, a solution containing 1 part sulphuric acid to 1,000 parts water is added, until the yellow colour just disappears. The liquid is then poured off and the paste is washed repeatedly with distilled water without reproducing the yellow colour. If the dry mercurous sulphate is white, and if it takes a faint yellowness only on repeated shaking with distilled water, it may be used at once. If no yellow colour appears on shaking with water, the salt should be repeatedly washed with distilled water until the first traces of yellowness appear.

For preparing the part, we add to 2 parts of the sulphate, by weight, about 1 part of mercury. If the sulphate is dry, it is stirred up with a paste formed of crystals of zinc sulphate and a concentrated solution of zinc sulphate, so that the whole forms a stiff paste, everywhere pervaded with crystals of zinc sulphate and small globules of mercury. If the sulphate is dry, only crystals of zinc sulphate are added, always in excess. The following points must be observed in the construction of the elements.

1. The mercury serving as a positive electrode must be most carefully kept free from contamination with more positive metals. Care must be taken that no particles of zinc amalgam come in contact with the mercury.
2. The arrangement of the element must be such that at all temperatures the total effective surface of the electrodes is in contact with solution of zinc sulphate.
3. The zinc sulphate used must contain no free acid.

THE UTILISATION OF TOWN REFUSE FOR POWER PRODUCTION.

By THOMAS TOMLINSON, B.E., Assoc.M.Inst.C.E.

(*Continued from page* 177.)

Taking the figures given last week from Mr. Jones's paper, it is possible to deduce from the answers to questions 11, 12, and 25, results in one of the forms already used, *i.e.*, I.H.P. continuously per cell consuming 6 tons per day of 24 hours. These results are :—

Batley—8½ I.H.P. continuously per cell burning 6 tons per day of 24 hours.
Birmingham—50 I.H.P. continuously per cell burning 6 tons per day of 24 hours.
Blackburn—5½ I.H.P. continuously per cell burning 6 tons per day of 24 hours.
Bury—3 I.H.P. continuously per cell burning 6 tons per day of 24 hours.
Ealing—4 I.H.P. continuously per cell burning 6 tons per day of 24 hours.
Hastings—5 I.H.P. continuously per cell burning 6 tons per day of 24 hours (without cremator).
Hastings—10 I.H.P. continuously per cell burning 6 tons per day of 24 hours (with cremator).
Heckmondwike—The weight of the loads is not stated.
Liverpool—4 I.H.P. per cell burning 6 tons per day of 24 hours.
Southampton—4 " " " "
Warrington—8½ " " " "

The high results obtained at Batley and Warrington are probably due to there being a very large proportion of coal and cinder in the refuse, since Batley (in Yorkshire) and Warrington (in Lancashire) are both situated in cheap coal districts, which naturally leads to large consumption and wasteful use.

The result obtained at Birmingham has been already commented on and its cause indicated.

At Ealing, Mr. Jones burns not merely ashbin refuse, but dried (not pressed) sludge in the proportion of two of the former to one of the latter by weight. The probable effect of this on the evaporative value per ton of the mixed stuff will be considered later when the question of sludge destruction is reached ; the fact needs stating here.

The result, 4 I.H.P. per cell burning 6 tons per 24 hours, is what is now attained, but not what is believed to be attainable when, after the erection of the electric lighting station, the whole waste heat is utilised. In fact, it merely represents the present utilisation (which is ample for all present purposes). The form of the reply to question 25 shows this : "We work two 10-H.P. engines ;" and at Bury and Heckmondwike, where similar replies are given, the same comment is applicable.

The low output per cell per 24 hours at Ealing is noticeable, and the cause instructive : To the municipal engineer, a hard clinker is of value for bottoming footpaths, &c. ; a loose, friable clinker is of no value, and Mr. Jones reduces his output in order to obtain the hard clinker he requires. A small practical point worth notice.

The noticeable point about Hastings is the reply to question 25, from which it appears that there is a substantial return in power from the use of the town cremator, which will have to be considered later.

I cannot reconcile the figure (4 I.H.P. per cell) obtained above with the figure (7·5 I.H.P. per cell) previously deduced from Mr. Bennett's paper on "The Utilisation of Town Refuse, Sewage Disposal, and Electric Lighting at Southampton," already referred to. The latter figure was deduced from the statement in the paper, that 25 tons burnt in six cells ran an engine indicating 31·5 H.P. for 24 hours ; but it was also stated that this 25 tons was the minimum daily supply, which at times rose to a maximum of 50 tons, and it may be that the figure 7·5 I.H.P. is a trial figure obtained under favourable conditions, and the figure 4 I.H.P. the actual average value in practical continuous work.

Coming now to anticipations : — At Widnes the town council have before them a proposal (see Electrical Review, April 17th, 1893), based on the report of their borough surveyor.

The proposal is for a 6-cell destructor to deal with 10,000 tons per annum, and in connection with it is to be "a boiler capable of producing 40 H.P., an engine to drive a mortar mill, stone breaking machine, &c., and an electric light installation." The account adds further, "The cost of gas lighting for the street lamps and the above-named buildings would be about £150."

This proposal is clearly on the lines of the Southampton result, taking the 40 I.H.P. as available for all the hours of the year for a consumption of 10,000 tons. We have

35 I.H.P. hours per ton of refuse burnt.
8¾ I.H.P. continuously per cell burning 6 tons in 24 hours.

The saving to be obtained by utilising for electric lighting the surplus power available, after the necessary municipal work of stone breaking, clinker crushing, &c., is provided for, is noticeable, £150 per annum on a consumption of 10,000 tons per annum.

In an interview (*Lightning*, March 9th, 1893), Mr. Manville, M.I.E.E., in answer to this question, "Would the refuse of an ordinary parish be sufficient, as a rule, to provide all the light and power likely to be required ?" replied, "Quite! I don't think the amount of power which might be realised by the burning of ashbin refuse in various places is appreciated."

This is Prof. Forbes's statement without the saving "ifs," and with power added as well as light, one is therefore prepared for high figures. We learn that "as much as 400 H.P. for 24 hours a-day is available from this source (Shoreditch refuse)," as we find the refuse stated as 20,000 tons per annum, the resulting figures are :—

175 I.H.P. hours per ton of refuse burnt.
43¾ I.H.P. continuously per cell burning 6 tons in 24 hours.
1·5 lbs. of water evaporated per ton of refuse burnt.
0·15 evaporative value compared to coal.

So far as published results known to me go, this result can be obtained as at Birmingham, and not otherwise.

Prof. Henry Robinson, M.Inst.C.E., and Mr. W. N. Blair, Assoc.M.Inst.C.E., reported to St. Pancras Vestry (*Electrical Engineer*, June 9th, 1893) on a proposed new electric light station in connection with a destructor plant.

In one part of the report we find, "If the capacity of the 18 cells thus provided be taken as 10 tons per day (and there is every reason to believe that the consumption of refuse will not be below this amount), the depôt will be capable of disposing of 1,080 tons of refuse during the week, and 60

tons of refuse would be burnt in the cells under the boilers on Sunday, to keep the electric light going." Elsewhere we find: "The power available from the destructors will be not less than 300 H.P. with the first instalment of three boilers, and 500 H.P. with the complete set of five boilers."

From the two extracts it may be inferred that 500 by 6 by 24 I.H.P. hours are expected for a consumption of 1,080 tons of refuse. The resulting figures are:—

66 I.H.P. hours per ton burnt.
16½ I.H.P. continuously per cell burning 6 tons in 24 hours.
0·6 lbs. of water evaporates per lb. of refuse.
0·06 Evaporative value compared to coal.

These results, it will be seen, are 10 per cent. in excess of Mr. Watson's claimed results already given (ELECTRICAL REVIEW, August 18th, 1893).

Referring to the L.C.C. report, we find St. Pancras with a population of 234,437 collects 78,000 tons of rubbish (6·6 cwt. per head), of which 60,000 tons (5·0 cwt. per head) is to be destroyed.

Mr. Watson's figures were obtained where 1·5 cwt. per head only was destroyed, and remembering the obvious deduction already made, of the decrease in calorific value as the amount dealt with is increased in quantity per head, it seems likely that Mr. Watson's figures should be reduced rather than increased, especially as from this plan I find the mean distance of 12 of the 18 cells is 120 feet from the boilers measured along the flues; this arrangement being rendered necessary by the large space occupied by the cells compared with the boilers, and by practical considerations dictated by the size and shape of the site—points worth considering in connection with the utilisation of the waste heat of destructors.

For another reason also Mr. Watson's figures must be reduced the moment you come to apply them to the ordinary working conditions of a central station; they are based upon evaporation, and the I.H.P. hour only represents an evaporation of 20 lbs. of water per I.H.P. hour. Now you cannot, in the ordinary average working of a central station, obtain an I.H.P. hour for anything like this. If you could, the unit of electricity would not cost 8 to 10 lbs. of coal.

Prof. Robinson and Mr. Blair are not, of course, relying solely on the waste heat of the destructors, arrangements are provided for hand or automatic stoking of the boilers as required.

Having learned that tenders were actually accepted for an electric lighting station in connection with the destructor at Ealing, I communicated with Messrs. Bramwell & Harris, the consulting engineers, and asked for an interview, which, in the absence of Sir Frederick Bramwell, Mr. H. Graham Harris courteously granted. In reply to my question as to the value of the waste heat from the destructors, he replied, "We expect to get continuously from the eight destructors (including the new one to be added) and the cremator, 50 I.H.P., specified to cost no more than 22 lbs. per I.H.P. hour, but which we expect to get for 20 lbs., and" he added. "I wish to say this, that from the position of the sewage works, on the extreme edge of the district, it is doubtful if we should have gone there at all for the sake of the waste heat, had it not been for the extra saving due to the utilisation of the sewage effluent for condensation, and the added economy of having the two municipal plants under one head."

It will be worth while later, when the electrical stage of these articles is reached, to investigate in a general way the limiting profitable displacement of an electric light station, in order to utilise the waste heat of a battery of destructors, under various conditions of distribution. Taking Mr. Jones's figures for consumption, 4½ tons per cell per 24 hours, and taking this consumption for 8 cells, we have—33 I.H.P. hours per ton of refuse.

The only other projected combination of destructor b ttery and electric light station of which I know is at Leyton.a

Here a battery of destructors for the burning of as hbin refuse and pressed sewage sludge is shortly to be erected. I have no particulars of the proposed destructors, and the engineer, Mr. W. Dawson, M.Inst.C.E., with commendable caution (especially as the type of the destructor will probably be new, since the combination of ashbin refuse and *pressed* sludge is new) declines to prophesy till he knows, and will see what it is worth, and take it for that.

Collecting, now, into tabular form the various figures already given, we have:—

Authority (where known).	Town or district.	1.	2.	3.	4.	Remarks.
?	Leeds	238·4	59·6	2·13	0·213	A theoretical deduction based on analyses of waste gases from a Horsfall destructor.
?	Birmingham	200·0	50·0	1·79	0·179	Boilers set directly over furnaces.
The author	Leeds	188·4	47·1	1·7	0·17	Corrected net external value from theoretical deduction given above.
Mr. Manville	Shoreditch	175·0	43·75	1·5	0·15	An anticipated result.
Mr. Watson	Leeds	134·0	33·5	1·2	0·12	Net external value from theoretical deduction given above.
Prof. Robinson and Mr. Blair	St. Pancras	66·0	16·5	0·6	0·06	An anticipated result.
Mr. Watson	Oldham	60·0	15·0	0·54	0·054	Claimed on result next given as allowance for excess temperature in escaping gases.
" "	"	42·5	10·6	0·38	0·038	Actually obtained result in two trials of four and six hours duration.
?	Hastings	40·0*	10·0	...	...	This result is with Jones's cremator. A second result is given below without the cremator.
Messrs. Bramwell & Harris	Ealing	34·0	8·25	...	...	An anticipated result—ashbin refuse and sludge mixed.
?	Batley	34·0*	8·25	...	...	Both in coal districts.
?	Warrington	34·0	8·25	...	...	
Mr. Bennett	Southampton	30·0*	7·5	0·27	0·027	As given in Mr. Bennett's paper. A second result is given below.
?	Blackburn	22·0*	5·5	...	...	Without Jones's cremator. See result given above.
?	Hastings	20·0*	5·0	...	...	
Mr. Jones	Ealing	16·0*	4·0	...	...	The plant is actually doing this now. See above for estimated value
Mr. Boulnois	Liverpool	16·0*	4·0	...	...	
Mr. Bennett	Southampton	16·0*	4·0	...	...	As given in reply to Mr. Jones's circular. See result given above.
Mr. Cartwright	?	12·0*	...	...	...	
?	Bury	12·0*	3·0	...	...	
Mr. Hewson	Leeds	8·0 to 10·0*	...	...	...	

NOTE.—The columns headed 1, 2, 3, 4, give, respectively:—(1) I.H.P. hours per ton of ashbin refuse, taking 20 lbs. of water or 2 lbs. of coal per I.H.P. hour (except where the figures are marked with an asterisk, when the figure is actual I H P. as given by the authority quoted). (2) I.H.P. continuously per cell, consuming 6 tons per 24 hours. (3) Pounds of water evaporated per lb. of ashbin refuse burnt. (4) Evaporative value compared to coal at 10 lbs. of water per lb. of coal.

ELECTRICAL ENGINEERING AT THE WORLD'S FAIR.

[FROM OUR SPECIAL COMMISSIONER.]

VII.

The new heating process of Lagrange and Hoho, of Brussels, Belguim, has just been shown working here. It is a very curious process, and seems quite incomprehensible at first sight. In this process a rod of iron is raised to a white heat in a pail of water.

The experiment was made as shown in fig. 1. An ordinary wooden pail is three-quarters filled with water

slightly acidulated, a lead plate about 9 inches broad by 16 inches long dips to the bottom of the pail and is connected to the + pole of 110 volts incandescent dynamo machine capable of giving over 150 ampères. The iron rod, or article to be heated, is connected to the — pole of the dynamo, and simply dipped into the water; it immediately becomes heated and rapidly rises to a melting temperature,

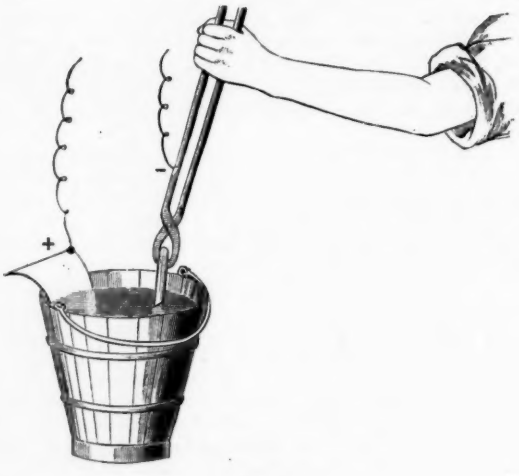


FIG. 1.

only that portion of the metal completely immersed becomes heated, and the heating is so rapid that neither the water nor that portion of the metal out of the water becomes very warm.

Wrought-iron and steel actually melt if long enough held under the water. A carbon rod subjected to this process becomes amorphous carbon, proving that a temperature of at least 4,000° Centigrade has been reached, and it is stated that with 220 volts pressure a temperature of 8,000° Centigrade has been reached.

There are various theories to account for this phenomenon; but from close observation, it appears to be a case of arc heating. The moment the metal is plunged into the water it is enveloped in hydrogen gas decomposed from the water. This envelope of gas parts the water and metal, forming an arc, which raises the surrounding gaseous envelope to an enormous temperature; the metal surrounded by this arc is almost immediately raised to the same temperature. A flame of burning hydrogen appears round the metal on the surface of the water.

The principle of the method is the same as upon which the burning of an arc light between two carbon points under water depends. An arc lamp will burn quite steadily under water if the connections are made waterproof; the arc itself requires no protection.

JAPANESE ELECTRICAL ENGINEERS.

There has just been opened a stand in the Electricity Buildings showing exhibits from Japan by the Myoshi Electric Works, Tokyo, makers of dynamos, motors, lamps, and fittings. The principal features of interest are in their Siesmometers for recording the behaviour of earthquakes. Earthquakes are so frequent in Japan that the natives have become the foremost authorities in the World on the subject; they have studied earthquakes for a long time, as a drawing of a Siesmometer invented by one, Choko, about A.D. 127, proves.

Their chief electrical exhibits are electroliers, very elegant; 5, 3, 2, and 1 light electroliers and brackets all made of bamboo. At first glance one would think they were metal, they look quite artistic and show what clever workmen can do with a very common material.

VIII.

THE TELAUTOGRAPH.

Among telegraphs this is the only novelty shown, and it is the centre of much interest; the instruments look thoroughly practical, and, after a little practice, writing by the tied up pen becomes quite easy.

The two instruments—transmitter and receiver—are very like each other. The transmitter is shown in fig. 1. An ordinary lead pencil is used, near the point of which two silk

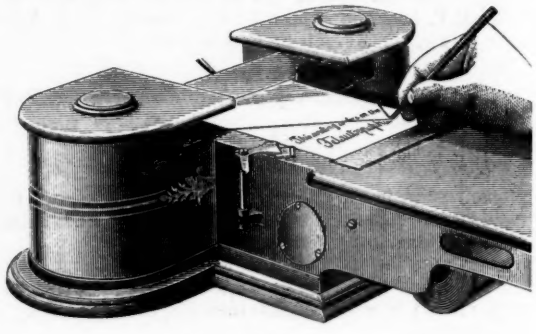


FIG. 1.

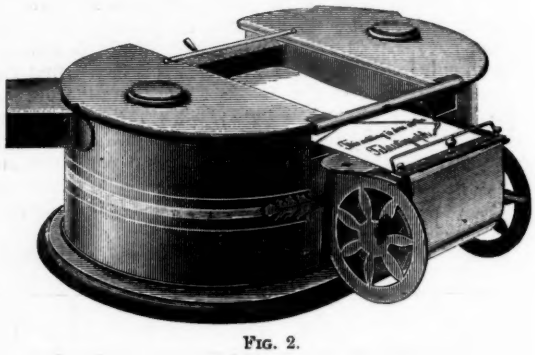


FIG. 2.

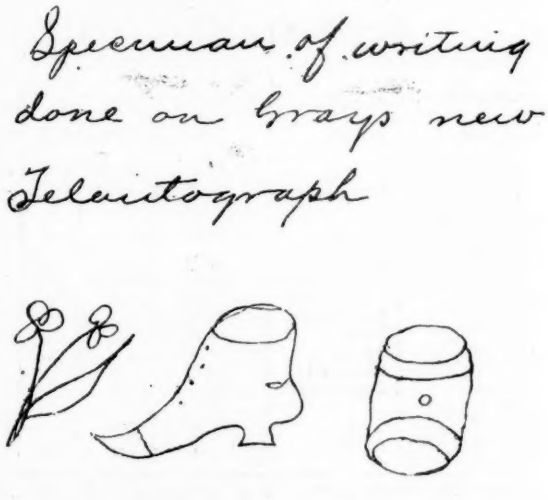


FIG. 3.

cords are fastened at right angles to each other; these cords connect with the instrument, and, following the motions of the pencil, regulate the current impulses which control the receiving pen at the distant station. The writing is done on

ordinary paper 5 inches wide. At the transmitter the paper is moved forward by hand; at the receiver it moves electrically.

The receiver is shown in fig. 2. The pen is a capillary glass tube supplied with ink by a rubber tube from a reservoir. The pen is moved by the electrical impulses coming over the wire, leaving an ink tracing in *fac simile* of the sender's writing or drawing.

Fig. 3 is a message as sent, and fig. 4 a message as received.

FIG. 4.

The idea of the writing telegraph is not new. English electricians can well remember the Cowper-Robertson telautograph, in which this same mechanical device, moving two variables at right angles was used, as, in this more perfect instrument. In the Cowper-Robertson instrument the variables at the sender were two resistances, and at the receiver two electro-magnets at right angles.

In this new instrument, step by step movements have been adopted, on the well known principle of the step by step telegraphs. The pencil used at the transmitter has two silk cords attached to it near the point, running off at right angles, each cord passes round a small drum on a vertical shaft; attached to the same shaft is a toothed wheel, so arranged that when the cord winds upon or off its drum, a number of teeth will pass a given point corresponding to the movement of the pencil, and each tooth sends an impulse over the line, moving the corresponding drum through the same distance at the receiver end; the movement at the receiver end is made by two escapement wheels, like those used in step by step telegraphs.

Actuated by polarised relays, and so constructed that each electrical impulse received from the line permits the escapement wheel to feed one step either forward or backward, these escapes are mounted on vertical shafts which carry drums of the same size as those of the transmitter. To these drums are attached, by means of cords, pen arms of aluminium, which are hinged at the point where the pen is carried. Two line wires are required, one for each of the cords on the transmitting pencil.

A close examination of the writing received will show that the step by step character of the writing is apparent.

THAMES PLEASURE STEAMBOATS.

By invitation of Mr. Arnold Williams, managing director of the Victoria Steamboat Association, Limited, a large number of representatives of the Press had the opportunity on Thursday, last week, of making a trip to Margate and Ramsgate in the fine paddle steamer, *Royal Sovereign*. The *Royal Sovereign* is a saloon paddle steamer, 312 feet in length; breadth of hull, 33 feet; extreme breadth over paddle-boxes, 58 feet; and depth, moulded to main deck, 11 feet. In view of the important service in which the vessel is engaged, great attention was given to the sub-division of the hull into watertight compartments by steel bulkheads, to ensure that the vessel should be practically unsinkable, and in this direction effect was given to the fullest extent to the recommendations of the recent Bulkhead Committee, the *Royal Sovereign* being, in fact, one of the first vessels of her class to conform to the necessary qualifications. Built and engined by the Fairfield Shipbuilding and Engineering Company, Limited, Glasgow, the ship is a splendid example of high-class workmanship. Two spacious deck saloons, forward and aft of the machinery space, respectively, give the vessel a most handsome appearance, and serve to provide both classes of passengers with airy and comfortable accommodation in the event of rain. They thus avoid the stifling crush too often experienced when shelter is more limited. Above the saloon the deck extends fore and aft the full breadth of the vessel, and affords an excellent promenade. On this deck are two houses of teak wood. The midship house contains a large private cabin framed in polished mahogany, and upholstered in the finest scarlet morocco, with Brussels carpets, chenille table covers, and brocade window curtains. There is also the captain's cabin, and a purser's room and ticket office. These are finished in polished hardwood, suitably furnished and upholstered in velvet, with brocade window curtains. Connected with the ticket office is a post office, where letters, telegrams, and parcels will be received for despatch at the various places of call. Over this house is the navigating bridge, with the usual steering standard and telegraphs to the engine-room, mooring stations, bow rudder, and windlass. The after-house, also of teak, is fitted as a first-class smoking room and bar, with all necessary fittings. The forward part of the promenade deck and the whole of the forward deck saloon, including a separate smoking and refreshment room, are reserved for the use of second saloon passengers; and the accommodation here provided closely approaches the comfort and luxury of ordinary first saloon accommodation. In the deck saloon, which is finished in polished teak, will be found a bookstall and a coffee buffet, which has proved a very great convenience. The dining saloon is immediately below, and is finished in white enamel; the seats are covered with carriage repp, and merino curtains are fitted to all the ports. Particular attention has been given to the ventilation of all the compartments, especially the dining saloons; and patent exhaust and inlet ventilators are fitted, which cause a constant current of fresh air. There is, of course, the full complement of boats and life-saving appliances to the latest Board of Trade regulations, and one of the lifeboats is kept hanging from the davits ready for launching at any moment. The life-saving appliances take the form almost entirely of seats in the nature of rafts with halyards attached, each of which will support many persons in the water. The steamer is licensed by the Board of Trade to carry 2,320 passengers. The *Royal Sovereign* is fitted with compound diagonal surface-condensing engines. The cylinders are placed side by side, and work on two cranks set at an angle of 90°. The high pressure cylinder is 50 inches diameter, and the low pressure cylinder 82 inches diameter, each adapted for a stroke of 5 feet 6 inches. The crank and paddle shafts are of mild steel, the crank shaft being forged in one piece, and connected to the paddle shafts by flanged couplings. Each cylinder is fitted with a flat slide valve, worked by the usual double eccentrics and link motion, and the starting and reversing are effected by one of Messrs. Brown Brothers' steam and hydraulic reversing engines. The condenser is cylindrical, and placed between the cylinders and the supports for the crank shaft. An ample supply of condensing water is supplied by a centrifugal circulating pump, worked by a separate engine, and made by Messrs. W. H. Allen and Co., London. Steel has been used where possible, so as to minimise the weight of the engine. The two paddle wheels are constructed on the feathering principle, each wheel being fitted with curved floats. The wheels are of steel throughout. Steam is supplied by four low double-ended steel boilers, designed for a working pressure of 120 lbs. per square inch. Each boiler has four corrugated furnaces, making a total of 16 furnaces. A fan is fitted in each stokehole, to be used if required, to maintain a sufficient supply of air, and to assist the natural draught under adverse atmospheric conditions. For convenience and safety in going astern or turning in harbour or narrow channels, two rudders have been fitted, one at the bow in addition to the ordinary one aft. The latter is worked by a steam-steering apparatus fitted on the engine platform, and thus under the immediate care of the chief engineer, and, as is usual, controlled by suitable connections from the wheel on the captain's bridge. The bow rudder is provided with a patent screw-steering gear, with necessary locking pins. The vessel may thus be steered by either head or stern. The stipulated speed of the vessel is 19½ knots with natural draught, and this has been fully maintained, the engines having worked without a hitch. Mr. P. B. Black, naval architect, superintended the construction of the steamer, which was completed in a remarkably short space of time.

In June, 1888, Mr. Arnold Williams, who had shortly before become connected with the Victoria Steamboat Association, Limited, determined to adopt the electric light on some of his vessels. The first was the *Alexandra*, and the lighting of this vessel consisted of 26 incandescent lights fitted in the fore and aft saloons, with a Tangye engine driving a Mackie dynamo, erected in a small house on the deck close to the engine room. The next year he had the *Glen Rosa* and *Duke of Edinburgh* fitted, the installation on these boats being for 20

lights each, with Hindley's engines driving Mackie dynamos by belt, and placed in a small house on deck. The *Duke of Edinburgh* that year was the vessel which brought the Shah of Persia up to London, and had at that time 10 extra lights for decorative purposes. The following year Mr. Williams thought that the public were not having sufficient attractions to induce them to go much on the river, so he made the first departure, according to his ideas of what a river pleasure boat should be, by building the *Cardinal Wolsey* and the *Mermaid*. The former boat is of very shallow draft, owing to the state of the river at low water above Kew Bridge, and she has been afloat every day with a very large number of passengers up to Hampton Court and back. The saloons are very handsomely furnished, and the innovation of having windows instead of port-holes, enables all those who prefer to stay below the opportunity of seeing the sights on the river. She has 20 electric lights, and a Tangye engine and belt-driven dynamo in her engine room. The *Mermaid*, running between Southend and London, is a miniature *Koh-i-Noor*, having 26 lights, the engine and dynamo having been taken off the *Alexandra*. The success of these boats, together with the growing popularity of the whole of the river service under his direction, induced Mr. Williams the next year to do something further to improve the down-river traffic. He bought the well-known *Lord of the Isles*, and brought her round from the Clyde, but before bringing her round he had her fitted with the electric light. As space in her engine room was not available, the engine and dynamo were put in a small room at the back of the engine room on deck; the plant in this instance consisting of a Robey vertical high-speed engine coupled direct to a Mackie dynamo running at 300 revolutions per minute, and serving 65 incandescent lamps. All the fittings are electro-plated and well arranged, to give ample light. Later, owing to the success he had met with in endeavouring to please the public, Mr. Williams had the *Koh-i-Noor* designed and built under his own instructions, and according to his own ideas. The vessel was constructed by the Fairfield Shipbuilding and Engineering Company at Govan, and this year the *Royal Sovereign*, another vessel slightly larger, and with a few improvements in the accommodation for passengers forward, but in other respects a sister ship, has been added to the Thames. The *Koh-i-Noor* runs to Clacton and Harwich and back, and the *Royal Sovereign* to Margate and Ramsgate and back in the day. The electric light plants of each vessel consist of a Robey high-speed vertical engine coupled direct to a Mackie dynamo running at 350 revolutions per minute, and mounted on a cast-iron foundation fitted in the engine room, together with the switchboard controlling all the circuits, numbering six, for 175 lights in all. In running the wires to the lamps none of them are anywhere to be seen, advantage being taken to place them along the ventilators that go right through the lower saloons, and on the upper deck along the fore and aft beams, where they have to cross to get to the pendants. The wires are run in casing between the panelling and the decks, the casing being of ample size, so that the wires can be pulled back into the ventilator, and examined and replaced without disturbing the decorations of the ship. Not only are the saloons and offices fitted, but the crews' quarters also have the lights.

It has been generally recognised that the introduction to the Lower Thames of two steamers like the *Royal Sovereign* and the *Koh-i-Noor* has marked a revolution in the excursion traffic of the river. In this movement Mr. Arnold Williams has been the chief pioneer. He has resolved to place upon the water boats superior in character to any with which the public had previously been acquainted. But before this result can be fully achieved, it is absolutely necessary that corresponding development should be entered upon in the existing pier accommodation. Both Old Swan and Tilbury piers require to be considerably lengthened, and there is room for change in another direction. Regulation is necessary just as much in connection with barge traffic as with passenger traffic, and some limit ought to be rigidly enforced with the view of preventing large numbers of lighters being moored together. To the neglect of this precaution must be attributed the trouble which has arisen in the navigation of some of the large excursion steamers. Beyond this it was openly stated, at the dinner given on board, that barge owners are in the habit of deliberately placing their craft in the way of river steamers in order that they may be sunk or injured, with the sole object of claiming heavy damages against the owners of the steamboats which have to pass through this unpleasant and unjust ordeal. No one sympathises with racing or with any other practice which imperils the safety of human life, but it is only right that an even hand should be held by the river authorities to all the interests concentrated in the Thames.

The guests were treated with the most lavish hospitality by the directors, and we desire to tender our thanks to Colonel FitzGeorge, chairman, Mr. Williams, managing director, Mr. Shand, Mr. Goss, Captain Fishenden, and indeed to all the officials on board, for the great courtesy which the representative of the ELECTRICAL REVIEW experienced at their hands. The Association is to be congratulated on the free use it has made of the electric light, the 10 ships of the fleet carrying somewhere about 560 lamps, and to Mr. W. Mackie, their contractor, no small praise is due for the admirable manner in which he has carried out his work.

To the overworked professional man—and who is not overworked in the electro-technical industry—we can recommend nothing more exhilarating, invigorating, and refreshing, than a trip to healthy and bracing Margate and back on board the *Royal Sovereign*, and we cordially wish Mr. Arnold Williams and his coadjutors that success which their efforts so richly deserve, and which sooner or later must result, for the British public is not slow to recognise genuine pluck and enterprise, especially when directed towards the pleasure and rational enjoyment of the masses.

The *Royal Sovereign* is, we understand, the first vessel which has performed the journey to Margate and Ramsgate and back to London in a day, and the delight of such a journey is being already appreciated by increasing numbers of people.

CORRESPONDENCE.

Electrical Engineering at the World's Fair.

In your issue of August 4th, page 122, your Special Commissioner's notes on "Electrical Engineering at the World's Fair" are, in one respect, a little inaccurate. Under the heading, "Railway and Tramway Motors," after enumerating, amongst others, the General Electric Company's Motor, your Commissioner goes on to say that "it is very remarkable that all these railway motors are designed with very large armatures and weak fields. The American designs for ordinary stationary motors, as built by most makers, are built with strong fields and weak armatures, as theory and practice has long ago settled as correct; yet, when they come to design tramway or railway motors, we find the practice quite contrary to the theory." Let us take an example: The iron-clad single reduction motor, W P_{30} type, is built of cast steel, of which a saturation curve has been given (*vide* ELECTRICAL REVIEW of May 12th and 26th, 1893), in an article by the present writer. The cross-section of armature is $38\frac{1}{2}$ square inches of iron; the cross-section of iron in the field is 63·13 square inches.

The W P_{30} motor, when loaded so as to take 30 ampères, would then have an induction in the field of 10·3 Kapp lines per square inch, which is far from being a saturated field. Such a motor, starting with a car fully loaded on a greasy track, would take a current of 40 ampères, more or less; this is a fair average starting load, as determined by actual experiment. The number of ampère turns would be 40 ampères × 275 turns = 11,000; and it should be observed that this class of motor has only one field coil. Referring to the curve mentioned above, the induction in the core will be found to be 20·4 Kapp lines; the maximum figure for good iron in cores being given as 26 per square inch (*vide* Kapp "Transmission of Power," 3rd edition, page 120).

Lines per sq. inch

$$= \frac{\text{volts} \times 10^6}{\text{area iron in inches} \times \text{speed} \times \text{turns of wire on armature}};$$

and in the case of the field core it will be found that the induction at this load, far from being over-saturated, does not exceed 13 Kapp lines per square inch. The induction in the armature core of this machine was designed for 17 Kapp lines per square inch. It seems to me that the statement: "The field magnets must be far over ordinary magnetic saturation," is hardly correct. It is probable that your Commissioner may have overlooked the fact that the field magnets are of cast-*steel*, and not of cast-*iron*. The induction for steel with small quantities of carbon is almost equal to that of wrought-iron. As your Commissioner has indicated his opinion as to the correct class of motor design, as practised in America, viz., stationary motors, it will be well to take an example. A Thomson-Houston (General Electric Company) type D_{15} motor has the same electrical input as the above class of W P_{30} motor of the tramway type, 15,000 watts with upright form of horse-shoe field magnets. The cross-section of the field magnets is 74·66 square inches of wrought iron, and that of the armature is 74·59 square inches. In other words, in the stationary type of motor the cross-section of iron in the field and armature is approximately the same; whilst in the case of the tramway motor, the ratio of the cross-section of the field to the cross-section of the armature = 1·62 : 1. Your Commissioner therefore, it seems to me, has been somewhat sweeping in his deductions when he says that "*all* these railway motors are designed with very large armatures and weak fields."

J. D. Dallas.

August 22nd, 1893.

ELECTRICAL SPECTACLES!

IN our last issue there appeared a paragraph regarding the imposition practised upon a young woman in Wales, by an Irishman and his son. A contemporary, published every "morning," has had the kindness to reproduce that note but without having the courtesy to acknowledge the source of its information.

In the columns of another contemporary, the *Standard*, on

Wednesday, there appeared a letter from a correspondent *apropos* of the practices of quack oculists. We will notice one instance in particular, *i.e.*, that of a very poor old woman—dwelling at some almshouses—who had been called upon by one of these gentry and informed that her eyesight was defective. Poor as she was she was eventually talked into paying him one guinea for a pair of so called "electric spectacles," which afterwards proved to be worth less than a shilling. Quite a number of instances of the heartless methods of these bogus ophthalmologists are quoted by the writer of the letter to which we refer. The *Standard* also calls attention to the matter in a leaderette. The following outspoken extract is worth quoting:—

We are quite ready to believe that any number of similar instances might be cited; nor is it by any means certain that the poor and ignorant are alone liable to be defrauded and maltreated by rascals who sell "electric spectacles," and similar paraphernalia of extortion—professing to relieve or remedy defects in vision pronounced by ordinary practitioners to be hopeless. . . . . In the interests of those who have no means of distinguishing between false and true, it may be asked whether something cannot be done to circumvent the incompetent and fraudulent oculist. The unlicensed practitioner in this branch of surgery should be visited with the same penalties as would certainly overtake the amateur who cuts off human limbs. . . . . Of course, as the law stands, the victims of bogus eye-doctors may bring their deluder to book. They may sue him for damages and in most, if not all, of the cases quoted, they might institute criminal proceedings. . . . . In the distant future, it may be hoped, the march of intellect produced by universal education will alone suffice to drive every kind of impostor into an honest way of earning his living; but, in the probably lengthy interval before that ideal is realised, something might surely be done for the protection of the weak and foolish, even at the risk of perpetuating the evils of "grandmotherly legislation." The only difficulty is to know where to stop in a crusade against this kind of fraud. Perhaps at no period in our social history have the Dr. Sangrados, of high and low degree, been more active, more enterprising, and more successful; nor is it easy to say exactly where quackery ends and the honest and honourable art of healing begins.

It would be a welcome sign if the whole of the daily press would take upon itself the deprecation of quackery of all kinds, and treat all imposture in the same wholesome manner. But when two systems of imposture are practised almost side by side, the one infinitesimally small as compared with the other, and the papers condemn the former while the wholesale vendor of such fraudulent electrical appliances is left undisturbed, it does not tend to produce great confidence in the daily press, especially when it is observed that the man whose wares are condemned does not advertise his business, and the other spends a fortune in advertising. We would remark that our contemporary which now so strongly condemns the vendors of quack electrical spectacles, absolutely abstained from making any comment whatever, upon a recent *cause célèbre* in which the ELECTRICAL REVIEW took a prominent part. The comparative merits of the appliances to which we directed our attention and electric spectacles, we leave our readers to work out for themselves.

ON THE TRANSMISSION OF ELECTRIC SIGNALS THROUGH SPACE.*

BY W. H. PREECE, F.R.S.

IN the year 1842, Henry showed how the disruptive discharge of a Leyden jar in an upper chamber of his house magnetised needles in a cellar 30 feet below.

In 1884, telegrams sent to Bradford (England), in Morse characters, from the General Post Office, London, through a gutta-percha covered copper wire in an underground iron pipe, buried in the street, were read upon an open telephone circuit consisting of an iron wire carried on poles on the housetops 80 feet away.

In 1885, Mr. Edison showed how it was possible to communicate with a moving train by utilising the electrostatic influence between a circuit erected upon the poles on the side of a railway and a telephone circuit carried by the train.

In the same year, I made many experiments to determine whether the effects observed in England were due to electro-magnetic induction, and were quite independent of the earth; and also to find out how far the distance between the wires could be extended before this influence ceased to be evident.

With our ordinary telegraph working currents the region of disturbance reached a distance of 3,000 feet; while the effects were detected on parallel lines of telegraph, 10¼ miles apart, between Durham and Darlington. Even between the East and the West Coasts at the Border, a distance of 40 miles, currents produced at Newcastle on the Jedburgh line were distinctly heard at Gretna on a parallel line. These latter results, in the North of England, were vitiated by the presence of a large network of railway and other telegraphs between the two places, and as they may not have been due solely to direct electro-magnetic induction through space, but to electrostatic effects between neighbouring wires as well, I took a district in the West of England, between Gloucester and Bristol, along the banks of the River Severn, where for a length of 14 miles, and at an average distance apart of 4·5 miles, no intermediate disturbing conductors existed between the pole lines. The valley of the Mersey, and several other localities in England where no disturbing elements existed, were similarly investigated.

It is necessary at the outset to point out that if we have two parallel conductors separated from each other by a finite space, and each forming part of a separate and distinct circuit, either wholly metallic or partly completed by the earth, and called respectively the *primary* and the *secondary* circuit, we may obtain currents in the secondary circuit either by conduction or by induction, and we may classify them into those due to—

1. Earth currents.
2. Electrostatic induction.
3. Electro-magnetic induction.

It is very important to eliminate (1), which is a case of conduction, from (2) and (3), which are cases of induction.

1.—EARTH CURRENTS.

When a linear conductor dips at each end into the earth, with which it makes a good connection, and voltage is impressed upon it by any means, the resulting return current would probably flow through the earth in a straight line between these two points if the conduction of the earth were perfect; but as the earth, *per se*, is a very poor conductor indeed (and probably is a conductor only because it is moist), lines of current-flow spread about symmetrically in a way that recalls the figure of a magnetic field. These diffused return earth conduction currents are evident at great distances.

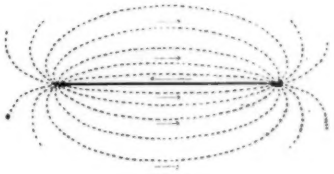


FIG. 1.

These lines of current-flow are very easily traceable by means of exploring earth plates or rods. The primary current is best produced by alternating currents of such a frequency as to excite a distinct musical note on a telephone, and if these currents rise and fall, periodically and automatically, they produce an unmistakable wail. If they are made and broken by a Morse key they can transmit readable signals. The secondary circuit, which contains the receiving telephone, is completed in the case of the earth by driving two rods into the ground, or, in the case of water, by plates dipping into the water at a distance of from 5 to 10 yards apart.

In this way the Town Moor, near Newcastle, the sands and the land about Lavernock and Penarth on the coast of South Wales, the water of the Bristol Channel, the towns of Liverpool and Leeds, and London itself, have been thoroughly explored; and it has been proved that the distance to which these lines of flow can be detected depends upon the intensity of the primary current flowing, on the area of the surfaces in contact with the earth, on the resistance of the portion of the earth utilised, and on the dryness of the season. In London the currents working the City and South London Electric Railway affect recording galvanometers at Greenwich 4½ miles away, and a diagram of the train service on the railway can be recorded in any part of the metropolitan area.

The distance in sea-water is not so extensive, for the latter is a better conductor than earth; still, with primary currents of 15 ampères, effects have been traced to one-third of a mile.

In all cases where disturbances have been created by electric tramways they have been shown to be greater in summer than in winter.

It is very necessary to be able to distinguish or separate these earth currents from currents due to induction, for they are very apt to give false effects and to lead to erroneous conclusions. This is easily done, if the instrument be sensitive enough, by making the primary current continuous when the earth current also becomes continuous, while induction currents are momentary and are observed only during the rapid rise or fall of the inducing cause.

2.—ELECTROSTATIC INDUCTION.

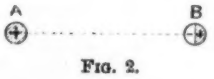


FIG. 2.

When a body, A (fig. 2), is electrified by any means and isolated in a dielectric, it establishes an electric field about it. Lines of electric force are projected from it in every direction; and if in the direction of any of these lines of force there is placed another similar body, B, it is also electrified by induction. If B be placed in connection with earth or with a condenser or with any large body, then the charge of

* Read at the Chicago Exhibition on Wednesday last.

the same sign as A is conveyed away, and B (fig. 3) remains electrified in the opposite sense to A, and to the same amount. A and B are seats of electric force. They form a stress, and are the ends of a line of force. The dielectric between them is displaced or polarised electrically. It

FIG. 3.

is in a state of strain and remains so as long as A remains charged, but if A be discharged or have its charge reversed or varied, then similar changes occur in B and through the dielectric separating them.

FIG. 4.

If A (fig. 4) be a flat disc electrified positively and be placed inside a ring, B, then the ring becomes the termination of lines of electric force, and the sum of their terminal negative charges is equal to the whole positive charge of A. A may, in each of the above cases, be the section of a continuous wire or conductor forming part of a complete circuit. The charge on A may be due to the electric force of a primary current,

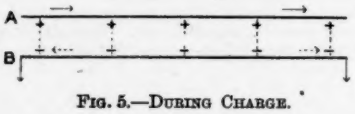


FIG. 5.—DURING CHARGE.

while in the secondary conductor, B, the displaced charge in flowing to earth establishes a momentary current whose direction and duration depends on the current of A, and on its rate of variation.

The strained state of the dielectric and the charges on A and B remain quiescent so long as the current flows steadily; but if the

FIG. 6.—STEADY CURRENT.

primary current ceases, then we have secondary currents in each conductor, as shown by the arrows, and flowing until equilibrium is restored.

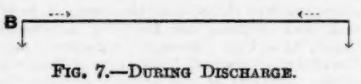


FIG. 7.—DURING DISCHARGE.

The secondary currents, due to discharge, flow in opposite directions at each end, and there is always some intermediate zero point.

It is thus easy in long circuits by observing their direction to differentiate currents of induction due to electric displacement from those due to electro-magnetic disturbance.

The dielectric plays just as important a part in the electrical operations that occur as do the conductors. Its molecular disturbance cannot be neglected. It is subject to strain and variations of displacement in one direction, while it is permeated by a wave of energy in another direction, viz., in the direction of the primary current. In fact, it is a question much discussed at the present day whether the prime action in all current effects is not this wave or flux of energy passing longitudinally through the dielectric in the direction of its length, and that nothing whatever passes through the conductors, which are mere passive agents in the matter, wasting energy but not transmitting it.

There are two views of the formation and support of a current. The one following Faraday regards it as the continuous discharge of the contiguous charged molecules of the conductor, the action originating in and being propagated uniformly throughout the conductor. The dielectric plays only a secondary part. The other derived from Maxwell by Poynting regards a current as the consequence of the propagation of a wave of electrical energy through the dielectric in the direction of the line and which reaches the wire from the exterior. The conductor plays a secondary part, it simply dissipates the energy conveyed by the dielectric. The current is set up on the surface and it penetrates the interior comparatively slowly, while its distribution in any given sectional area of the conductor is not uniform.

The truth lies probably in a combination of each view. The dielectric is as much an essential agent in the action as the conductor, and in each plane, perpendicular to the current, the charge and discharge of contiguous molecules, the formation of an electric field, the formation of a magnetic field, the flow of energy across this plane and parallel to the conductor, its dissipation as heat in the conductor are all simultaneous and self-dependent, and equally concerned in the final result.

In a complete metallic loop the energy is propagated in the dielectric between the wires; it is dissipated in the wires, there are longitudinal waves propagated through the dielectric parallel to the wires, and there are other circular electro-magnetic waves emanating from each conductor as a centre and flowing as a resultant in planes perpendicular to the wires. Thus there are lines of electric force, lines of magnetic force, and lines of energy flow. The first determine displacement, and are controlled by electrostatic capacity; the second determine electro-magnetic disturbance, and are controlled by inductance; the third determine transformation of energy, and are controlled by resistance. Time enters into the consideration of the longitudinal speed of the energy-flow through the system, of the electro-magnetic disturbance through the dielectric at right angles to this flow, of the rise and fall of the current at each point of the circuit, of the character of the current, whether continuous or alternating, and, if alternating, of the frequency of the complete alternations.

The effects of electrostatic induction do not play an important part in the enquiry immediately before us, but they are of great consequence in considering questions of speed of signalling in submarine cables and clearness of speech in long distance telephony.

(To be continued.)

BUSINESS NOTICES, &c.

J. A. Berly's Universal Electrical Directory for 1893 (12th year), 784 pp. This standard work, now under the direct supervision of the proprietors, H. Alabaster, Gatehouse and Co., contains a larger amount of trade information than any other similar publication, and should be in the hands of every engineer or electrician. Free within the Postal Union for 4s.

Blackpool Electric Tramways.—The Corporation Tramway's account states that "The interest of the Blackpool Electric Tramway Company, Limited, in the Blackpool Tramway, was bought on September 9th, 1892, by the Corporation, in exercise of their option to buy at the end of the first seven years of the term of twenty-one years of the lease. The purchase-money was £15,750. Taking from it to stock £325, usable materials, and adding £104 for expenses on the transfer of the property, make £15,529 as the capital amount of this purchase, which included centre channel, engines and electrical fittings, tram shed building, cars, &c. With the amount spent by the Corporation in 1884 to 1887 on the outer rails, sett-paving, &c., £13,435, the total cost of the tramways becomes £28,964. The expenditure after September 9th, 1892, to March 25th, 1893, on revenue account is £2,964, made up of station expenses (coal and coke, wages, repairs, oil and waste, water, gas, &c.), £489; road expenses (wages of drivers, guards, checkers, &c., repairs to centre channel, motors and gearing of cars, roadway and outer rails, cars, &c.), £1,208; general expenses (rates and income tax, printing books and stationery, fare boxes, rents of tram shed, land and North Shore office, salaries of manager and clerks, car licenses and fire insurance, &c.), £567; and loan charges £700. The receipts from cars for the same period are £2,247, and rents of advertising spaces on cars and tickets £114, together £2,361, leaving a deficiency of £603 carried forward."

A Blackpool daily remarks regarding the frequency of accidents on these tramways of late, such as the cars running off the metals, missing the points, and delays due to the breakage of the rope which is fixed underneath the cars. The week before last three cars left the metals in one hour, but fortunately through all the heavy traffic of the holidays no casualties have occurred. A very narrow escape was witnessed on Saturday night, when a tram starting from the Victoria Pier, had proceeded for about 300 yards and then left the metals with a suddenness which caused the passengers to rock on their seats. The car ran almost on to the footpath on the west side of the road, while the scene was intensified by the glare caused by the return current of electricity. The service was delayed for a time, but was eventually resumed. We understand a similar incident occurred on Tuesday evening last week.

Croydon Tramways.—In the course of his speech to the shareholders of the Croydon Tramways Company, on Tuesday, the chairman, Mr. W. J. Carruthers-Wain, said: "You will find that there was an item in our accounts in the previous half-years, which does not appear on this occasion. I refer to the electric traction. The Electric Traction Syndicate has not yet been able to renew its running on our line, or to make any definite arrangement in relation to the matter. We are, therefore, minus the traffic from that particular form of traction, which was a novelty, and which, like all novelties, was extremely beneficial to the traffic. We have had sent to our lines, for the purpose of experiment, one or two new motors, which are to be run at the expense of the owning company and not at your expense, so that you will have the advantage of any additional traffic that those motors may bring to the line. It all brings grist to the mill, and so long as it does not do you any harm or cost you any money, we do not think we are doing any harm in endeavouring to facilitate the development of some economical form of traction which may some day take the place of horses, and be the means of still further saving the expenses of the company."

Chelsea Electricity Supply Company, Limited, v. London Electric Supply Corporation, Limited.—This was a motion which came before Mr. Justice Wright on Wednesday on behalf of the plaintiffs for an injunction to restrain the defendants, their workmen, servants, and agents, from laying any distributing main or mains for the supply of electric light within the area described in Schedule A of the Chelsea Electric Lighting Order, 1886, except as provided by an agreement between the plaintiffs and the defendants, dated July 9th, 1889, until the trial of the action. In 1889 certain litigation was pending between the plaintiffs, the Chelsea Electricity Supply Company, and the defendants, the London Electric Supply Corporation, and for the settlement of these disputes an agreement dated July 9th, 1889, was entered into between the two companies. By clause 2 of the agreement (*inter alia*) the London Company undertook that they would not, without the consent of the Chelsea Company, for a period of seven years from the date of the confirmation of a provisional order, which was then being applied for by the London Company, voluntarily supply electricity within the area described in Schedule A of the Chelsea Company's Act, and that they would not take any direct action to cause themselves to be required to supply electricity within such area, or to hinder the Chelsea Company from supplying within such area, or to compete voluntarily with the Chelsea Company within such area. On the 7th inst. the defendants opened ground southwards in Sloane Square, nearly at right angles to the pipe or pipes in their trunk main near Upper George Street, and they have since carried on the work of opening the ground as far south as the Court Theatre. The plaintiffs' secretary made an affidavit, saying that he believed that, unless restrained by injunction, the defendants would insert distributing mains in pipes or a pipe along the ground they had so opened up and elsewhere in the plaintiffs' area of supply. This, the plaintiffs submitted, would be in breach of the agreement of July 9th, 1889. On behalf of the defendants it was contended that the agreement was void as being contrary to the provisions of the Electric Lighting Act, 1882 (45 and 46 Vict, c. 56), section 11, which provides that "no local authority, company, or person shall by any contract or assignment transfer to any other company or person or divest themselves of any legal powers given to them, or any legal liabilities imposed on them by this Act, or by any licence, order, or special Act, without the consent of the Board of Trade." The Court granted an injunction in terms of the motion. Mr. Justice Wright said,—Both companies are bound by section 11 of the Act of 1882. The defendant company has agreed that it will not voluntarily supply electricity within a certain area, and it now says that is a void agreement. I think it is not. If that is so the London Company has not overriden the Act by this agreement. The contract is that they will not until required supply the electricity. I cannot hold this agreement bad. There must be an injunction until the trial.

Clarke, Chapman & Co.—We understand this firm are very busy in their electrical department, being at the present time engaged in installing electric light outfits on no less than 16 steam vessels, including the large Japanese cruiser the *Yoshino*, now building at the Elswick Yard of Messrs. Armstrong, Mitchell & Co., the contract comprising the search-light projectors, &c. They have also in hand the lighting of the three large passenger steamers now building on the Tyne for the Norddeutcher Lloyd Co., at the yards of Messrs. Armstrong, Mitchell & Co. and Messrs Wigham, Richardson & Co., each installation comprising one 24 kilowatt and one 12 kilowatt machine each driven by a vertical compound engine besides several large cargo and oil carrying vessels. They have also in hand the lighting of Messrs. Ferguson's mill at Carlisle, besides projectors for Suez Canal traffic, belt driven dynamos, and other work. A good illustration of the careful study they have made of the special requirements of ship lighting is given by a small illustrated instruction book issued with each installation to the chief engineer, containing full particulars of the installation, together with clear instructions as regards the proper working of the generating plant and installation generally, the working projectors, &c., with a large amount of other information of a very useful character. The book is of convenient size and is got up in a very handy and neat style.

The Lighting of Engineering Works.—Last week the new Craiginches works of Messrs. Harper, Limited, were lighted up by electricity for the first time. There are no less than 55 arc lamps, aggregating 75,000 candle-power and absorbing three-fourths of the available power of the dynamo, which has a capacity of 100 ampères and a voltage of 260 when run at 725 revolutions per minute. The dynamo is driven by a large Tangye gas engine, which assists a duplicate engine to drive the main shafting for the whole works. The gas required to drive the dynamo when the whole place is lighted up is only 550 feet per hour. This economy is probably due to the particular arrangement of installation and the careful selection of the apparatus and lamps, all of which are of the most modern design and manufacture. The installation is a great success, and is said to be the largest of the kind in Scotland, the Glasgow central station having little more than half the number of lamps. It has been arranged by Mr. F. Hoppert, electrical engineer, of London, who fitted it up. The offices are also lighted up by 35 incandescent lamps, so that no gas is used throughout except for driving engines, of which there are three altogether, to the total exclusion of steam.

Dissolution of Partnership.—We are informed that the partnership heretofore existing between George E. Belliss and Alfred Morcom, carrying on business as engineers and boiler makers at Ledsam Street Works, Ledsam Street, Birmingham, and at 9, Victoria Street, S.W., under the style of G. E. Belliss & Co, was dissolved by mutual consent as on and from June 30th last. All debts due to and owing by the said late firm, will be received and paid by G. E. Belliss & Co., Limited, which has acquired and will continue the business.

Windsor Electric Lighting.—The Windsor and Eton Electric Lighting Company suspended operations on Saturday last, and has gone into liquidation. The *Windsor Gazette*, commenting on the subject, considers that the company received very little encouragement from the public, and considerable opposition from the local authorities. Our daily contemporary suggests the acquisition of the plant and business by the corporation.

At meetings of this company, held at the registered office, Acre House, Windsor, on July 24th and August 10th, 1893, the following resolutions were passed:—1. "That it has been proved to the satisfaction of this meeting that the company cannot, by reason of its liabilities, continue its business, and that it is advisable to wind up the same, and accordingly that the company be wound up voluntarily, and that a liquidator be appointed for the purposes of such winding up. 2. "That William Sevenoakes, of Acre House, Windsor, secretary and managing director of the said company, be and is hereby appointed liquidator for the purposes of such winding up."

Creditors of the company are required, on or before September 30th, 1893, to send their names and addresses, and the particulars of their debts or claims, and the names and addresses of their solicitors (if any) to the liquidator.

An Electric Light Company Summoned.—At Lancaster Castle, last Saturday, the Morecambe Electric Lighting Company was summoned at the instance of the Morecambe Local Board for having broken up the Marine Road, and failed to reinstate and make good the same. Mr. Tilly, Clerk of the Local Board, prosecuted, and Mr. Jowitt, secretary, appeared for the company. Mr. Tilly said that the Local Board had spent a great deal of money in putting the Marine Road in good order, having it rolled with the steam roller, and they had no sooner got the road into good condition than the defendant company began to break it up to lay cables. They had taken up about 160 yards of road, but had left it in a very rough and unsettled state, and though repeatedly asked to put the road into good repair, the company had failed to do so. Since May 24th about 12 notices to repair roads damaged in laying cables, had been served upon the defendant company. Mr. Jowitt said the blame rested with their contractors. A fine of 20s. and costs was imposed.

Derry Electric Lighting.—The first instalment of £5,000 has been received by the Corporation on account of the above works. The generating station is nearly completed by the contractor. Messrs. Alexander Brown & Sons have two boilers on the ground, and are proceeding to place them in position. The erection of the fuel economiser has been completed. A staff of men are engaged erecting the street lamp pillars. The engines and machinery for which this firm has tendered are in a forward state, and will be erected as soon as the engine foundations are laid, and the storage tank, travelling crane and feed pumps are also ready. Messrs. Siemens Bros. & Co., Limited, have two of the dynamos, and also the switchboard, ready for delivery, and the remaining dynamos are nearly completed. It is expected that this firm will proceed immediately to lay the street mains. On the whole, the lighting scheme is said to be in a fair way to be fully installed about the month of October.

Church Electric Lighting.—Huddersfield Parish Church is being fitted up for electric lighting by Messrs. Ernest Scott and Mountain's local representative (Mr. E. J. Wilmshurst). The nave of the church is lighted by means of 72 incandescent lamps, the old gas brackets having been utilised for the display of these, as well as the two standards in the transept for the 18 lamps with which this part of the church is illuminated. The organ will have one lamp placed over the keyboard, and a lamp protected by a wire guard for the pedal light. In the pulpit a lamp has been fixed to the existing bracket, and in the choir stalls nine lamps have been placed on each of the two standards with which the stalls have previously been illuminated. A similar arrangement has been made with respect to the two lamps fixed in the chancel. The galleries are lighted by means of pendants, and provision has also been made for the effective lighting of the vestries, entrances, porches, &c.

Elmore.—We cull this from the *Financial Times*:—"A correspondent, signing himself 'Jay,' writes calling our attention to another scandalous affair in connection with the Elmore group:—'Last February,' he says, 'I applied for a little of the First Mortgage Debenture stock offered by the French Elmore Company. I paid two 25 per cent. calls, but as no definite allotment appeared to be made, I asked for the return of my money. On March 24th I was informed the amount I had paid was lying in the bank and would be returned to me as quickly as possible. I have written several times since, but seem as far off as ever from obtaining my money. I should like to join others in the same position in taking legal action for the recovery of my cash.' It is bad enough to get Elmore scrip in exchange for sovereigns, but to get nothing is a little worse, and we should be glad to know if others of our readers are in the same awkward position."

Drake & Gorham.—This firm has obtained the contract for the lighting of Balliol College, Oxford. The hall, which is an exceptionally fine building, will be treated somewhat in the same manner as the Court Room at the Bank of England, and the Grand Hall at the Inner Temple, the lighting of which has been so much admired, and in order to get the best effect the lamps will be fixed temp rarily in the proposed positions and the fittings afterwards made to suit. Messrs Drake & Gorham adopted this method in the case of the Bank of England, the result being eminently satisfactory. 100 lamps are being installed for the immediate requirements of the College.

B. Verity & Sons.—On 21st inst. the newly-erected public library and baths in Great Smith Street, Westminster, were opened. Messrs. Verity & Sons have carried out the electric light installation.

Coventry Electric Lighting.—With reference to the note in our last week's issue we learn that the Corporation have resolved to undertake the supply of electrical energy themselves. The high tension system is to be adopted for private lighting, and street lighting is not at present to be undertaken. A site is to be purchased at £350 per acre and a station erected of 150 kilowatt capacity, to supply 4,300 8-C P. lamps with mains and transformers suitable for 12,000 similar lamps. Application is to be made to the Local Government Board for the usual borrowing powers. Tenders are to be obtained for the buildings. Out of four specifications submitted for the plant, the committee have selected those of the Brush Company and Messrs. Hammond & Co. (with Messrs. J. Fowler and Co.) as best adapted for Coventry.

Agency.—Messrs. Bergtheil & Young have been appointed sole European agents to the Mica Insulator Company, of New York, for the sale of this material, which, it is thought, will prove a very valuable form of insulator. By its use one secures the full benefit of the insulating properties of pure mica with the advantage that micanite is procurable in large sheets up to 36 by 36 inches (or even more if specially required), and may be made to almost any shape desired. The price is practically that of small mica, which material is very expensive and almost unobtainable in large slabs. It has been hitherto impossible to mould it or to work it to a required form.

The British Medical Association.—At the meeting of this association held at Newcastle recently, there were a number of exhibits of electro-medical appliances. Messrs. Arnold & Son showed Dr. Lewis Jones's instrument for the electrolysis of nævi. Messrs. A. Hurst & Co. showed a great variety of electrodes, sledge coils, constant current batteries and electric lighting instruments, a large thermo-electric pile, also an electro-mechanical vibrating apparatus for the treatment of neuralgia, several complete sets of apparatus for utilising electric current as derived from the mains for medical purposes, including electrolysis and constant current application.

What Municipal Authorities are Doing.—Leicester.—It is satisfactory to find that the opposition against the introduction of the electric light into Leicester by the Corporation has dwindled into mere querulous fault-finding. The Board of Trade have recently held an enquiry on the granting of the loan, the town clerk making out a splendid case for the town undertaking the supply. Numerous witnesses were called to show the probable demand for electric lighting.

Lighting at Düsseldorf.—The report and balance sheet just published for the year 1892-93 of the administration of the municipal gas, water and electricity works is very satisfactory. As far as the electrical department is concerned, after writing off a desirable amount for depreciation, there remains a surplus of £300. The expectations of the use of the electric light in the town have been realised.

Business Alteration.—We understand that Messrs. Pontifex & Wood, Limited, of Shoe Lane, London, have transferred their "Farringdon" pump trade, also "Penberthy" injector and ejector business, to Messrs. W. H. Willcox & Co. They are retiring from business, and Messrs. Willcox have purchased the stock of these goods from them, also sight feed lubricators, &c.

Annual Outing.—The employés of Roger Dawson, Limited, of 53, Berner's Street, W., went for their annual outing last Saturday, journeying in four-horse brakes to Windsor. Cricket and boating were the chief amusements, and a large party went up the river in a launch. The weather was all that could be desired, and the day was, on the whole, most satisfactory and successful.

Electric Freezing and Cooking.—By invitation of Mr. E. R. Dale, a large party of ladies and gentlemen visited the electrical works at Sherborne to inspect the improved ice-cream machine worked by electricity. Electric cooking apparatus was also shown in operation.

Central Station Catalogue.—One of the most beautiful catalogues that we have ever received has come to hand from Messrs. Parsons. Central stations are dealt with in a manner not often seen in a trade catalogue, the whole being graced by some splendid Meisenbach blocks.

Asylum Electric Lighting.—The Killarney Local Board have approved of the introduction of electric lighting into the lunatic asylum in lieu of gas, and have resolved to advertise for tenders for installation for 450 lights on a specification to be drawn up by the engineer of the Board of Control.

Traction at Nuremberg.—The tramway company propose to experiment with electric cars on the trolley system on the line Plarrer-Dutzendteich. An agreement has already been made with the General Electricity Company, of Berlin, and the consent of the local authorities is now awaited to proceed with the work.

London Platino-Brazilian Telegraph Company.—The directors announce that the half-yearly coupons, which fall due on September 1st, of the £100,000 6 per cent. debentures, will be paid on and after that date by Messrs. Glyn, Mills, Currie & Co.

Electricity in Agriculture.—A threshing machine operated by an electric motor, energised by current transmitted over a distance of 650 feet is now in operation on the farm of Mr. W. Schliman at Linde, in Western Prussia.

The Three-Wire System for Bradford.—In his half-yearly report the chairman of the Electric Lighting Committee recommends the conversion of the present system into the three-wire, at a cost of £2,920.

The Edison-Swan Company and the Huddersfield Corporation.—The Edison-Swan Company wanted to exhibit their various manufactures at the municipal station, but the Corporation will have none of it.

New Branch.—In response to the wishes of a large number of clients for whom Messrs. Drake & Gorham have arranged installations in Manchester and the neighbourhood, the firm have opened permanent offices at 100, King Street, Manchester.

W. H. Willcox & Co.—This firm have sent us copies of their lists of the "Penberthy" patent injector and "Farringdon" patent pumps lately sold by Messrs. Pontifex & Wood.

City of London College Lectures.—We have received a copy of the syllabus of the various classes and lectures to take place during the approaching session, 1893-94, commencing at Michaelmas.

New Engines for Bradford.—It is probable that the tender of Messrs. Siemens for two new engines and dynamos, and two switchboards, costing £3,025, will be accepted.

Ayr Undecided.—The town authorities of Ayr cannot decide upon taking up the supply of electricity. However, the Board of Trade, upon application, have deferred the revocation of the order.

Buda-Pesth.—A section of the new electric tramway in this town has been opened to traffic.

The Derby Station.—The Municipality station is well advanced, the machinery being put into position.

NOTES.

Identical Magnetic Fields.—In order to reproduce magnetic fields of identical intensity, Dr. d'Arsonval uses a subsidiary coil in series with the main solenoid, and inserts a mercurial thermometer into it. The eddy currents generated in the mercury by the alternating field cause a rise of temperature in the subsidiary coil, which is a measure of the field strength; with four Leyden jars the temperature rises to 150° C. in a few seconds in Dr. d'Arsonval's apparatus.

Maximum Current Interrupter.—An apparatus has been devised by Mr. Martin for restraining consumers from putting on too many lamps. When the current reaches the maximum amount paid for, an interrupter is automatically switched in, which makes the lamps "bob." It has two objections, clockwork and mercury. A short abstract is given in the New York *Electrical World*.

Traction at Halle.—The directors of the Hallesche Strassenbahn, Actiengesellschaft have decided to recommend at the forthcoming general meeting of the shareholders, the substitution of electric traction for their present system of horse haulage. It is believed that this recommendation will be adopted, and upon that a contract will be entered into with the Allgemeine Elektricitäts Gesellschaft for the carrying out of the work. The capital necessary, namely, £30,000, will be provided by the issue of new shares.

Manchester Overhead Wires.—Recently the question of overhead wires has been very fully threshed out by the Manchester authorities. Last week a member of the Council moved that the special committee be authorised to negotiate with the National Telephone Company on the subject of underground wires. An amendment, however, was carried that pending the result of certain negotiations at present in progress, it was expedient that any action in placing telephone wires underground be postponed.

Halifax Electric Lighting.—At the Local Government Board inquiry on 16th inst., it was stated that the estimated outlay for the electric lighting work was £23,800, and power was sought to borrow £30,000. The high tension system is to be employed, the central portion of the town being supplied from suitable sub-stations. The Halifax Mutual Electric Lighting Company very strongly opposed the application. They considered they had been unfairly dealt with. The ratepayers also entered stringent opposition on the grounds that the scheme would not pay.

New Rope Railway.—A wire rope railway operated by electricity was set in operation on the 17th inst. on the Stanzerhorn, in the canton of Unterwalden, Switzerland. The length of the line is over two miles, and the gradients range from 12 per cent. to 60 per cent.

The Electric Crane at Southampton.—At the last meeting of the Harbour Board, the Works Committee reported that the wharfinger and electrical engineer had been instructed to arrange for the discharge of a steamer's cargo as a test of the satisfactory working of the electric crane.

Appointments.—Mr. Dalton has been appointed tester in the electrical works of the Bradford Corporation for a period of three months, at a salary of £150 per annum.

For the post of assistant electrical engineer to the Huddersfield Council there were 46 applicants. Mr. A. E. Pullen, of Bournemouth, was appointed at £130 a year.

Electric Lighting of Public Buildings.—A proposal to erect an electric light installation, sufficient both for the new Police Office and Free Library, is under the attention of the Brechin Police Commission.

Workhouse Lighting.—The proposed electric lighting of Edmonton Workhouse is being considered by the Board of Guardians.

Keighley Lighting.—On the proposal of the extension of the gas works coming up at the last meeting of the Town Council there was some talk of electric lighting. The tenders in connection with the gasworks were, however, accepted.

Bristol Electric Lighting.—"Space" writes to the *Western Press* with a censure upon those who have caused to be erected in the narrow thoroughfares at Bristol such "ponderous" electric lamp standards. He considers something "slight and effective" should have been erected.

Leicester Electric Lighting.—A Local Government Board inquiry was held on 18th inst. regarding the Town Council's application to borrow £50,000 for electric lighting the borough. The Ratepayers' Association were represented in opposition to the loan. It was stated that a scheme sent in by the Brush Company, whose tender amounted to £26,977, had been accepted. The buildings would cost £4,000, and contingencies would raise the amount to £34,074, in addition to which the Council sought borrowing powers for £15,926 for future extension of mains. The Corporation, it appears, already have applications for 4,000 lights, and the plant will have a capacity of 7,200 lamps of 16 C.P. The ratepayers' representative urged delay of the matter for five years, in view of the heavy rates with which the town is burdened.

Eastleigh Lighting.—On the question of the public lighting coming up at a recent meeting of the Local Board, a member suggested that they borrow £4,000 at 4 per cent., and provide electric lighting instead of gas. Comparatively little notice was taken of the proposal by the other members. They had no doubt electric light was the coming illuminant, but it could not be obtained by the approaching winter.

Quartz Fibres.—A useful series of articles on "Quartz Fibres and Rods: how to make them and how to use them," is running through the New York *Electrical World* for the present month. So far, there is nothing much more than what Mr. C. Vernon Boys has told us; but the writer, Mr. Edwin F. Northup, promises fuller details and improved methods as the series goes on.

Tottenham and Electric Lighting.—A *Weekly Herald* correspondent writes a letter, short and to the point, regarding the lighting of Tottenham. The Local Board recently considered the better lighting of their district, and the gas company promised a more satisfactory supply. The writer of the letter referred to suggests that the Board let the public "have a taste of the electric light when the Library and Town Hall are built." He also hopes that the Board will consider the advisability and practicability of lighting the High Road electrically.

Past and Present.—Mr. Thomas D. Lockwood, in a recent series of articles, reviews the applications of electricity during the past 20 years. Speaking of the year 1876, he says: "The literature of the subject demands a notice, although it is of course quite out of the question that in this article I should discuss all the books and papers which from time to time have been published. It is sufficient to state that Jenkin's 'Electricity and Magnetism,' the telegraphic text books of Pope, Culley, and Preece (the latter just issued), the well tried classic of De La Rive, the matchless work of Maxwell, and the 'Experimental Researches' of Faraday might, 17 years ago, have been regarded as a good outfit for an electrician; while for English-speaking periodicals, we had in the United States, the *Journal of the Telegraph*, the *Telegrapher*, shortly to pass away, and the *Operator*, an aspiring but scarcely adolescent sheet, destined to bloom out in a few short years into the *Electrical World*; and in England, the TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW." Coming to the present day he says: "In electrical periodicals addressed to the English speaking and reading races, we find that while the *Telegrapher* of 1876 scarcely survived that year, and while the *Journal of the Telegraph*, having fulfilled its mission, has resolved itself into a tariff circular, the *Operator* has by successive steps become metamorphosed into the *Electrical World*, and the field of American electrical journalism has also been entered and is admirably occupied by the periodicals bearing respectively the names of the *Electrical Engineer*, the *Electrical Review*, the *Western Electrician*, *Electric Power*, the *Electrical Age*, and *Electricity*. In Great Britain the sub-title of the TELEGRAPHIC JOURNAL has displaced its quondam associate, and the old established journal has long been known as the ELECTRICAL REVIEW, while the *Electrician*, started in 1878, and the *Electrical Engineer*, some years later, are also excellent papers."

Electrical Engineer Wanted.—The South Shields Town Council are inviting applications for the appointment of a resident electrical engineer, whose duties will be to draw up detailed specifications of the proposed works, to advise upon the acceptance of tenders, superintend the construction of the works, and to undertake the supervision of the installation when complete, and to perform such duties as may from time to time be required by the Electric Lighting Committee and the Council; salary £200 per annum. The person appointed will be required to devote the whole of his time to the duties of his appointment.

Coast Communication.—The first Report of the Royal Commission appointed to enquire into the best means of providing communication to lighthouses and lightships, recommended that one of the first lightships to be connected should be the Kentish Knock. This is an important light, fixed about 18 miles off the coast of Essex, and occupying a central position among the light vessels placed at the entrance to the Thames. The vessel itself is now under repair, and when it returns to its moorings in a few weeks' time, the cable connection will be at once made. It will be connected with the Kingsgate Coastguard Station. The lighthouse at the Needles will also probably be provided with permanent communication at an early date. The experimental connection by means of a non-continuous cable, the signals being produced by induced currents, will, it is thought, be abandoned, at this station, and a continuous cable laid down. But the experiment, which it will be remembered was conducted by the Telegraph Construction and Maintenance Company, is considered sufficiently successful to warrant its further trial at another station, but no decision on this point has been arrived at.

Exceedingly High Temperatures.—Messrs. Lagrange and Hoho, before the Belgian Academy, stated that a temperature of 800,000° C. can be attained by means of a process they have discovered of passing an electric current through an electrolytic bath. As pointed out by the New York *Electrical World*, this makes no allowance for changes of state, &c. That being so, we do not see why the line should be drawn at 800,000; if the latent heat of vapourisation and a few other factors can be neglected, there is no reason why we should not ultimately arrive at a still higher temperature—say 800,001° C.

Fatal Accident.—The provincial dailies record an inquest on the body of Samuel Sykes, an electrician, employed by the Midland Railway Company at Leeds, which was held on Monday. On Saturday he was replacing a carbon in a lamp at the entrance to the goods station, Hunslet Lane, Leeds. He neglected to wear the India-rubber gloves provided, and receiving a slight shock from the wires, fell off his ladder, a distance of 18 feet. When taken to the Infirmary he was found to have sustained a fracture of the spinal column, and only survived a couple of hours. Witnesses expressed doubts whether Sykes was stunned by the electric current, but they agreed as to his receiving a shock sufficient to startle him. A verdict of "Accidental death" was returned.

Stage Illumination.—The Elektricitäts Aktien Gesellschaft, of Nürnberg, formerly Schückert & Co., announce that they have completed a new installation for lighting up the stages of theatres. It admits of modifying the degree of intensity of the lamps at pleasure, and of varying the character of the light by the introduction and removal of coloured lamps. White, red and green lamps come into use, and the "Regulator" gives the facility of causing two groups of lamps to burn simultaneously, either white and red, white and green, or red and green. It is possible to produce the following changing effects:—Bright daylight passes into evening twilight, and this again into a nocturnal effect with moonlight. This again gives place to a red morning dawn, which is succeeded by daylight. The arrangements for producing these several effects cannot be explained without the accompanying plates. The invention has been brought into successful action in various theatres in Germany, Denmark and Russia.

Humours of the Postal Telegraph Service.—The following letter appeared in the *Times* last Saturday from the pen of Frederick Leal. The necessity for some vast improvement in this direction is very evident:—"The humours of our postal telegraph service are exquisite. Let me give you a specimen? On a recent Sunday I wished to send a telegram from London to a spot in the North of England, which possessed a telegraph office. I handed my message in at Vere Street about 1 p.m. One of the clerks looked in the telegraph guide and informed me that the country telegraph office in question only opened for an hour or so on Sunday morning, that it had been closed some hours, and that I could not, therefore, transmit my message. 'But I want it to go,' I protested; 'what is the nearest telegraph office to it which is open, and what porterage shall I have to pay?' 'We cannot tell you the nearest telegraph office,' was the reply. 'Why not?' I asked; 'surely you have a map of England here?' 'No we have not. We have only a map of London.' 'Do you think they would have a map at the Charing Cross office?' 'They might.' I went on to Charing Cross. Precisely the same conversation took place. They had no map of England. 'Do you think they would have one at the General Post Office?' I inquired. 'They might,' was the reply. I went on to St. Martin's-le-Grand. Here, at the great centre of our postal telegraph service, they still had no map of England to guide them. 'What am I to do?' I asked. 'Oh, Sir,' was the reply, 'we expect the public, in these cases, to tell us the nearest telegraph office which is open at the other end, and to tell us how many miles the addressee lives from that telegraph office.' 'Then how do you make out your charge for porterage?' 'By the information with which the sender supplies us.' 'But supposing he does not know?' 'Then the telegram cannot go unless he makes a money deposit sufficient to cover all possible porterage.' Ultimately I sent my message by mentioning a town near which I believed my addressee lived, and by leaving a deposit for a three-mile porterage, together with my address, in case any further charge should be incurred. This is a very delightful state of things. It is like going into a shop to buy a hat, and saying to the counterman, 'I will buy such and such a hat.' 'You cannot have it, Sir.' 'Why not?' 'Because I do not know the price of it. Unless you can tell me the price of it, I cannot sell it to you.' 'But surely I, a customer, cannot know its value?' 'Very well, Sir, then you cannot have the hat.' Do maps of England showing all the telegraph stations already exist? If not, why not? If such maps do exist, how is it that the great telegraph centres are not supplied with them?" A number of other letters have since appeared in the columns of the *Times* on the same subject.

Electric Light at Huddersfield.—The Town Council have referred the question of the supply of electrical energy to the tenants of the Market Hall to a Sub-Committee.

NEW COMPANY REGISTERED.

Waterhouse Electrometric Syndicate, Limited (39,442).—This company was registered on the 17th inst. with a capital of £20,000 in £10 shares; to adopt an agreement made between A. G. Waterhouse, A. T. Salisbury-Jones, and J. J. Dale; to acquire all patents, rights, licenses, and privileges, and to work and maintain any reservoirs, vessels, electric works, warehouses, &c. The subscribers (with one share each) are: A. T. Salisbury-Jones, 33, Old Broad Street, E.C.; H. P. Amholz, 17, Great Winchester Street, solicitor; J. J. Dale, 33, Old Broad Street, accountant; A. G. Waterhouse, 67, Southwark Bridge Road, electrical engineer; F. W. Salisbury-Jones, 67, Southwark Bridge Road, engineer; P. B. Mills, 67, Southwark Bridge Road, electrician; G. Bidwell, 67, Southwark Bridge Road, mechanical engineer. The number of directors is not to be less than two nor more than seven; qualification, £100; remuneration (other than managing director), £100 each per annum. The managing director is to be A. T. Salisbury-Jones, with a remuneration of £250 per annum and 10 per cent. of the net profits. Registered by Russell and Amholz, 78, Great Winchester Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Edison and Swan United Electric Light Company, Limited.—The annual return of this company has been lately filed, and from it, it appears that out of a nominal capital of £1,000,000 in 150,000 "A" and 50,000 "B" shares of £5 each, 89,261 "A" £3 paid, 17,139 "A" fully paid, and 23,564 "B" fully paid shares, have been taken up. There has been 10s. called on each of 89,261 shares, and the total amount of calls received is £44,630 10s. There has been £223,152 10s. considered as paid on 89,261 "A" shares, £85,695 on 17,139 "A" shares, and £117,820 on 23,564 "B" shares.

Electric Wiring and Fitting Company, Limited—The registered office of this company is now situated at 2, Prince's Street, Great George Street, Westminster.

Electric Meter Company, Limited.—The registered office of this concern is now at Finsbury Circus Buildings, 18, Eldon Street, E.C.

Electric and General Investment Company, Limited.—The annual return of this company was filed on the 24th of last month, and shows that out of a capital of £200,000 in 39,900 ordinary and 100 founders' shares of £5 each, 20,000 of the former and the whole of the latter have been taken up. There has been £1 called on the ordinary and £5 on the founders' shares, and the total amount of calls received reaches £20,500.

East Coast Electric Light and Power Supply, Limited.—From a letter written by Mr. V. B. D. Cooper, now filed at Somerset House, it appears "that this company has failed to obtain parliamentary powers, that it has done no business, and that the company and the undertaking has been abandoned over six months ago."

Keighley Electrical Engineering Company, Limited—The annual return of this company shows that out of a nominal capital of £10,000 in £1 shares, 4,083 shares have been taken up. There has been £1 called on 783 of these, £728 has been received, £3,300 has been agreed to be considered as paid, and £55 is in arrear.

London Rubber and Packing Company, Limited.—The annual return of this company was filed at Somerset House a short time ago, from which we learn that out of a capital of £3,000, in £5 shares (15 founder's and 585 ordinary), the whole of the founder's and 245 of the ordinary have

been taken up. There has been £592 0s. 1d. paid, £150 agreed to be considered as paid, and £45 9s. 11d. is yet outstanding.

China and Japan Telephone Company, Limited.—The annual return of this company, made up May 30th, shows that out of a nominal capital of £20,000, in £1 shares, 14,761 shares have been taken up. The amounts on these have all been agreed to be considered as paid; and of this number the Oriental Telephone and Electric Company, Limited, holds 14,101.

CITY NOTES, REPORTS, MEETINGS, &c.

The Brush Company's Report.

On the whole we can fairly congratulate the Brush Company on its position at the present moment. Although there is considerably less gross profit than last year, there is no great difference between the net profits of the two years. It is proposed to pay an increased dividend of 1 per cent. on the ordinary shares, and this, it must be remembered, is on a larger capital than last year. It will be interesting to show how the capital account compares with the two past years:—

	1893.	1892.	1891.
Capital ...	£443,235	£385,149	£373,923
Debentures	£125,000 (4½ p. c.)	£111,347 (4½ p. c.)	£75,000 (6 p. c.)

In order to pay an increased dividend on a larger capital, there must have been considerable difference in the way money has been applied. Certainly the general charges are less than last year by about £2,500, which is due in a great measure to the absence of extra expense consequent on exhibitions. Although more work has been done, the total cost of labour has decreased. A consideration of the gross and net profits shows the following:—

	1893.	1892.	1891.
Gross profit ...	£49,405	£55,450	£42,712
Net profit ...	£26,394	£27,660	£19,354

It should be pointed out that last year a considerable sum fell due from the City Company, but against that the Brush Company had to pay off £22,000 worth of debentures which fell due. The dividends for the two years are as follows:—

	1893.	1892.
Preference	6	6
Ordinary	7	6

There are certain items in the report which, considered in the light of last year's, demand a little explanation. Last year the sum of £2,500 was set aside for maintenance of buildings and plant; this year, although there have been additions to buildings and plant to the extent of £10,000, only £2,368 figures for maintenance. In the appropriation account last year, £3,000 was applied to the reduction of property account, but no similar provision is made this year. The value of property, patents, and goodwill are lumped together under the sum of £273,321. It is unfortunate that the report is less explicit concerning these items, for it is always interesting to see what the directors think is a fair goodwill for their business—provided, of course, that they have no inflated notions of its value. It is satisfactory to find that the value of the goods in process of manufacture is much higher than was the case last year, because we understand that all work in hand at the present moment is to fulfil orders. The effect of removing to Loughborough cannot be felt yet, and there are therefore no indications in the report of saving in labour, coal, &c. There has been a regrettable decrease in Colonial business during the past year, the excess of assets over liabilities amounting to £61,492, against £82,737 in the previous year. The liabilities of the company are considerably less than last year, the amount due to creditors being £41,086, against £78,680 for the preceding year; the latter sum, however, includes £22,000 mortgage debentures which were paid off last year. The reserve account stands at £1,529, which for a company of this dimensions seems inadequate.

Bradford Electricity Supply.

As far as we can make out from the figures at our disposal, there has been an increase in the sale of current during the past six months. The sales up to the end of June 30th were £4,210, against £3,126.

	Last six months.	Previous corresponding period.
Gross profit	£2,293	£1,673
Net profit	£625	£387

This seems to be a highly satisfactory state of things; we hope to be able, very shortly, to put before our readers some further details of this last six months' working.

The Brush Electrical Engineering Company, Limited.

THE directors' fourth annual report, presented to the shareholders at the general meeting of the company, held at Cannon Street Hotel, yesterday, Thursday, August 24th, reads as follows:—

"The directors herewith submit the balance-sheet and profit and loss account for the year ended June 30th, 1893. The profit and loss account shows a gross profit of £50,158 6s., including the amount brought forward from last account, to which must be added £3,150 12s. 2d., the balance of premium after payment of expenses arising from the additional preference and ordinary shares issued during the year. After deducting standing charges, maintenance of buildings, plant, and patents, interest on debenture stock, and the whole cost of concentrating the company's works at Loughborough, amounting to £1,328 11s. 2d., there remains a balance of £26,394 12s. 9d. to be dealt with. After providing the full dividend on the 6 per cent. preference shares for the year, and an interim dividend at the rate of 5 per cent. per annum which has already been paid on the ordinary shares for the half-year ended December 31st, 1892, the directors recommend that the whole amount standing to the debit of preliminary expenses account, amounting to £1,575 2s. 3d., be written off; and that a further dividend at the rate of 7 per cent. per annum be paid on the ordinary shares for the six months ended June 30th, 1893, leaving £815 5s. 3d. to be carried forward. The capital account has been increased during the year by the issue of 15,000 6 per cent. preference shares, and 11,617 ordinary shares, which have been fully subscribed. During the year the sum of £10,681 19s. 10d. has been expended on capital account, chiefly in additional plant and buildings at Loughborough, and further extensions of the company's works there are still in progress. These extensions have been rendered necessary by the increasing volume of central station plant which the company are being called upon to manufacture. Good progress has been made with the construction of heavy plant for the Bankside Station of the City of London Electric Lighting Company, the dynamos for which are each capable of supplying current for 15,000 glow lamps of 8-candle-power. The first two of these are now delivered, and four more are in course of construction at Loughborough. During the past year the directors have concluded a satisfactory arrangement with the Otis Elevator Company, of Mansion House Buildings, E.C., for the manufacture at the Loughborough works of the elevators and other appliances required by them. In view of the growing demand for electrically worked lifts, arising from the introduction of electric supply into the leading towns of Great Britain and elsewhere, it is thought that the step which has been taken will prove of increasing advantage to your company in the future. The home business of the company generally continues in a healthy state; and the expiry of the Edison master glow lamp patent next November will probably give an additional impetus to central station development. Your directors have made arrangements to resume the sale of glow lamps of their own manufacture as soon as the above Edison patent expires. The Australian branch of your business has naturally received a severe check owing to the late financial crisis in the colonies, but your company has sustained no loss through any of the bank failures which have taken place. In Austria your business shows a steady growth, and the factory is kept fully employed on continental orders. During the year the municipality of Temesvar has purchased your central station there. The amount thus received has been deducted from the property accounts of your foreign and colonial branches, a separate balance-sheet of which is subjoined as usual. The outlook for the current year is good. Your works are at present fully employed, and fresh orders are coming in well, whilst in the coming year the full benefit of the economies anticipated from the concentration of the company's manufacturing operations at Loughborough should now be felt. It is believed that these economies will prove sufficient to provide the dividend upon the last issue of shares. The directors deeply regret to record the loss by death of the late chairman—the Duke of Marlborough. The active interest he displayed in all questions affecting the electrical industry causes his loss to your company to be the more keenly felt. Mr. J. B. Braithwaite has been elected chairman in his place. Mr. E. Garcke has resigned his position on the board, and, subject to the confirmation of the shareholders at the general meeting, Mr. Arthur Ayres has been elected to succeed him. Messrs. J. B. Braithwaite and B. H. Van Tromp retire by rotation, and, being eligible, offer themselves for re-election. The auditors, Messrs. Cooper Brothers & Co., also retire, and offer themselves for re-election."

BALANCE-SHEET, June 30th, 1893.

DR.	£	s.	d.
To Authorised capital	750,000	0	0
„ Capital issued—90,000 6 per cent. preference shares of £2 each, £180,000; 90,000 ordinary shares of £3 each, £270,000 = £450,000; less calls unpaid, £6,765	443,235	0	0
„ 4½ per cent. perpetual debenture stock	125,000	0	0
„ Creditors—Sundry creditors, £35,660 5s. 2d.; bills payable, £5,426 2s. 7d.	41,086	7	9
„ Reserve account, as per last account, less £1,550 3s. 10d. applied during the year...	1,529	16	11
„ Balance of profit and loss account, £26,394 12s. 9d.; less interim dividend paid on preference and ordinary shares, £10,500	15,894	12	9
NOTE.—Contingent liability in respect of uncalled capital on shares in other companies on guarantee and on bills receivable discounted, £9,429 13s. 9d.			
	£626,745	17	5

Cr.	£	s.	d.
By Property, patents and goodwill — As per last balance-sheet, £273,321 7s. 11d.; less written off last year, £3,000	270,321	7	11
Additions to buildings, £4,483 2s. 5d.; additions to plant, £5,422 9s.; expenditure on new inventions, £776 8s. 5d. = £10,681 19s. 10d.; less amortisation of leases, £733 6s. 10d.	9,948	13	0
„ Stock—Goods in hand in process of manufacture and materials at London, Loughborough, and other places...	91,555	11	6
„ Debtors — Sundry accounts, £117,645 11s. 8d. bills receivable, £1,895 6s. 3d.	119,540	17	11
„ Cash at bankers, and in hand	27,392	8	8
„ Shares and debentures in other companies ...	42,731	10	0
„ Provisional orders account	529	18	2
„ Preliminary expenses, as per last account, £2,375 2s. 3d.; less written off last year, £800 ...	1,575	2	3
„ Liquidators' balances and suspense accounts ...	1,657	9	10
„ Balance of foreign and colonial branches accounts, being excess of assets over liabilities	61,492	18	2
	£626,745	17	5

APPROPRIATION ACCOUNT.

Dr.	£	s.	d.
To Further dividend on preference shares at the rate of 6 per cent. per annum, and on ordinary shares at the rate of 7 per cent. per annum	13,504	5	3
„ Extinction of preliminary expenses	1,575	2	3
„ Balance carried forward	815	5	3
	£15,894	12	9

Cr.	£	s.	d.
By Balance	15,894	12	9
	£15,894	12	9

Examined and found correct,
COOPER BROS. & Co., *Chartered Accountants*,
London, *August 15th*, 1893. *Auditors.*

PROFIT AND LOSS ACCOUNT for the year ended June 30th, 1893.

Dr.	£	s.	d.
To General charges—Directors' fees, £1,968 15s.; auditors' fees, £105; salaries, £7,005 12s. 10d.; staff bonuses, £1,732 7s.; law charges, £292 5s.; insurance, £726 11s. 11d.; postage, stationery and printing, £1,007 1s. 8d.; travelling, carriage and freight, £852 0s. 10d.; advertising, agency and sundries, £3,738 4s. 7d.	17,427	18	10
„ Cost of removal to Loughborough	1,328	11	2
„ Maintenance of buildings and plant	2,368	4	7
„ „ patents	138	13	3
„ Interest on debenture stock to June 30th, 1893, and on 6 per cent. debentures paid off on December 1st, 1892	5,650	17	7
„ Balance, being net profit	26,394	12	9
	£53,308	18	2

Cr.	£	s.	d.
By Balance from last account	753	3	6
„ Premiums on new issue of shares and debentures, less expenses of issue	3,150	12	2
„ Gross profit	49,405	2	6
	£53,308	18	2

BALANCE-SHEET OF THE FOREIGN AND COLONIAL BRANCHES.

Being the Balances of the following accounts:—Vienna (made up to December 31st, 1892); Australia (made up to April 30th, 1893).

Dr.	£	s.	d.
To Creditors — Open accounts and bills payable, £57,183 14s. 11d.; unpaid balance of purchase price of land secured by mortgage, £7,250 ...	64,433	14	11
„ Balance of assets over liabilities transferred to general balance-sheet	61,492	18	2
	£125,926	13	1

Cr.	£	s.	d.
By Property — For freehold and leasehold lands, buildings, plant, tools, fixtures, &c., at Vienna, and in Australia	48,215	4	4
„ Stock—For goods in hand, in process of manufacture, and materials...	35,692	9	4
„ Debtors—Sundry accounts (after provision for doubtful debts) and bills receivable, including estimated profit to June 30th, 1893	40,581	8	0
„ Cash—At bankers and in hand	1,200	14	8
„ Shares in other companies	20	0	0
„ Australian suspense items	216	16	9
	£125,926	13	1

Mr. BRAITHWAITE presided at the meeting held at Cannon Street Hotel yesterday. He referred to the death of the Duke of Marlborough, the late chairman of the company, and to the other changes which had taken place on the board. Turning to the balance-sheet, they would observe that they had issued a certain amount of additional capital. The increase of the business had been so persistent and steady, that they had found it necessary to increase the capacity of the works at Loughborough, and at the present time the works' managers were crying out for further extensions. They would notice that trade creditors were a good deal less than last year. On the credit side there was an increase in what they called stock. If it had been ordinary stock he would have objected to it, but it represented additional work in hand. All the work in hand at the present moment was for orders. After referring to the decrease in the colonial and foreign accounts, he passed on to the consideration of the profit and loss account, where they would see there was a slight decrease in outstanding charges. Owing to the pressure of business, they had only just completed the concentration of the works at Loughborough, and they were hardly yet settled down. They anticipated large economies during the current year from this cause. The chairman mentioned the large machines they had built for the City of London Electric Lighting Company, which had turned out satisfactory. The increase in lighting business was likely to bring them their fair share of work as it was doing at the present. As traction extended, they would be able to compete very successfully. They had made arrangements for manufacturing and putting lamps on the English market.

After remarks from shareholders the report was adopted.

We shall publish a full report next week.

Oriental Telephone and Electric Company.

THE ordinary general meeting of the shareholders of the Oriental Telephone and Electric Company, Limited, was held on Wednesday at the Cannon Street Hotel.

Mr. WILLIAM ADDISON, the chairman, congratulated them on the steady increase of business, although the depreciation in the value of silver had prevented their showing any great improvement in the net results of the year's working as compared with those of last year. Their appeal to the House of Lords had been allowed, and consequently there was a sum of about £13,000 owing by the holders of vendors' shares on account of interest payable to the holders of ordinary shares during the first five years of the company's existence. Having detailed the causes of the litigation and its results, the chairman said there was a balance of profit of £9,085, which was increased by the amount brought forward to £11,043. The present board had always in their mind their promise not to make a call if it could be avoided; but to enable them to carry this out it was necessary to provide a substantial reserve fund, to which they now proposed to add £2,500, increasing it to £12,500. The dividend recommended was equal to £3 12s. per cent. on the ordinary shares. Their business was sound and progressive. He concluded by moving the adoption of the report, and the payment of a dividend at the rate of 2¼ per cent. for the year 1892.

Mr. H. GREWING seconded the motion, which was carried unanimously.

The Direct Spanish Telegraph Company, Limited.

THE directors' report for the half-year ended June 30th, 1893, to be presented at the general meeting of the shareholders, to be held on Friday, September 1st, 1893, reads as follows:—

"The annexed accounts for the half-year ended June 30th, 1893, show, after providing for debenture interest, a balance to the credit of profit and loss of £4,645 13s. 9d. The traffic receipts show a decrease of £593 8s. 9d. as compared with the corresponding period of 1892. The falling off in the receipts is chiefly due to the stagnation of Stock Exchange business in England, Spain and France. The working expenses are £130 6s. 5d. in excess of those for the corresponding period of last year. The company's cables, and the land lines in connection with them, have continued in good working order throughout the half-year. The directors report with extreme regret the death of Sir James Anderson, who had been chairman of the board since 1884. At the invitation of the directors, Sir John Pender, G.C.M.G., M.P., has joined the board to fill up the vacancy. The directors also have to report the death of Mr. Herbert R. Duke, the auditor of the company. They have, in consequence, requested Messrs. Deloitte, Dever Griffiths & Co. to audit the appended accounts, and an extraordinary general meeting has been convened after the ordinary general meeting to elect an auditor. After adding the usual sum of £2,500 to the reserve fund, the balance of profit and loss amounts to £2,145 13s. 9d. To this the directors propose to add £345 0s. 10d. from interest on investments, and recommend the payment of the dividend at the rate of 10 per cent. per annum on the preference shares, and a dividend at the rate of 4 per cent. per annum (free of income tax) on the ordinary shares. The reserve fund will then amount to £35,963 11s. 3d."

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending August 20th, 1893, amounted to £860; week ending August 21st, 1892, £724; increase £136; total receipts for half-year, 1893, £5,911; corresponding period, 1892, £5,385; increase £526.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending August 18th, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,386

SHARE LIST OF ELECTRICAL COMPANIES.

Present Issue.	Name.	Stock or Share.‡	Closing Quotation August 16th.	Closing Quotation, August 23rd.	Business done during week ended August 23rd, 1893. Highest.	Lowest.
195,100*l*	African Direct Telegraph, Ltd., 4 p. c., Deb. Regd. and to Bearer	100	99 —102	99 —102	...	...
1,134,640*l*	Anglo-American Telegraph, Limited	Stock	49 — 50	49 — 50	49	...
2,932,680*l*	Do. do. 6 p. c. Preferred	Stock	91½ — 92½	92 — 93	93	91½
2,876,140*l*	Do. do. Deferred	Stock	9 — 9⅛	9 — 9⅛	9⅛	9 3/16
130,000	Brazilian Submarine Telegraph, Limited	10	11⅜ — 12¼	11⅜ — 12⅜	12⅛	11⅜
36,400*l*	Do. do. 5 p. c. Bonds	100	99 —103	99 —103	...	...
75,000*l*	Do. do. 5 p. c., 2nd Series, repayable in June, 1906 ...	100	107 —111	107 —111	...	...
77,978	Brush Electrical Engineering Ordinary, Nos. 1 to 63,416	3	3¼ — 3½	3 — 3¼	...	...
75,000	Do. do. Non cum. 6 p. c. Preference, Nos. 1 to 63,416	2	2⅛ — 2⅜	2 — 2¼	2 3/16	...
125,000*l*	Do. do. 4½ per cent. Debenture Stock	Stock	107 —109	107 —109	109	108
20,510	Charing Cross & Strand Electricity Supply Nos. 1 to 6, 215 to 718, and 10,001 to 30,000	5	5 — 5⅛	5 — 5⅛	...	...
44,000	Chili Telephone, Limited, Nos. 1 to 40,000	5	2 — 3	2 — 3	...	...
630,000*l*	City and South London Railway	Stock	35 — 37 xd	35 — 37 xd	...	...
40,000	City of London Elec. Lighting Co., Ltd., Ord. 40,001-80,000 ...	10	10⅜ — 11¼	11 — 11⅛	11 3/16	...
20,000	Do. do. 6 p. c. Cum. Pref., Nos. 1 to 20,000	10	12¼ — 12⅜	12⅛ — 13	12 1/16	...
$7,716,000	Commercial Cable, Capital Stock	$100	120 —130	120 —130	124	123
224,850	Consolidated Telephone Construction and Maintenance, Limited ..	14/-	1/16 — 3/16	1/16 — 3/16	...	...
20,000	Crompton & Co., Ltd, 7 p. c. Cum. Pref. Shares, Nos. 1 to 20,000	5	4⅜ — 5⅛xd	4⅜ — 5 xd	...	...
50,000*l*	Do. do. 5 p. c. 1st Mort. Debs., 1—400 of £100, and "A" 1—200 of £50 each	...	101 —104	100 —103	...	...
16,000	Cuba Telegraph, Limited	10	11½ — 12½	11½ — 12½	...	...
6,000	Do. do. 10 p. c. Preference	10	18½ — 19½	18½ — 19½	...	...
12,931	Direct Spanish Telegraph, Limited, ... (£4 only paid)	5	2½ — 3½	2½ — 3½	...	...
6,000	Do. do. 10 p. c. Preference	5	8½ — 9½	8½ — 9½	...	...
60,710	Direct United States Cable, Limited, 1877	20	11¼ — 11⅜	11¼ — 11⅜ xd	11⅜	11¼
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	14⅞ — 15	14⅝ — 15	15	14⅞
70,000	Do. 6 p. c. Preference	10	16¼ — 16⅜	16¼ — 16⅜	16½	...
105,900*l*	Do. 5 p. c. Debs. (1879 issue), repay. August, 1899	100	106 —109	106 —109	...	...
1,294,100*l*	Do. 4 p. c. Mortgage Debenture Stock	Stock	112 —115	112 —115	114½	112½
250,000	Eastern Extension, Australasia and China Telegraph, Limited ...	10	15 — 15½	15 — 15½	15½	15⅜
70,600*l*	Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	102 —105	102 —105	...	...
250,200*l*	Do. do. Bearer Nos. 1050—3,975 and 4,327—6,400 ...	100	102 —105	102 —105	...	...
320,000*l*	Do. 4 p. c. Debenture Stock	Stock	110 —113	110 —113	111	...
108,700*l*	Eastern and South African Telegraph, Ltd., 5 p. c. Mort. Deb. 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343	100	101 —104	100 —103	102	101⅞
146,800*l*	Do. do. do. to bearer, Nos. 2,344 to 5,500	...	101 —104	100 —103	...	...
300,000*l*	Do. do. 4 p. c. Mort. Debs. Nos. 1 to 2016, red. 1909	100	101 —104	100 —103	102½	101
49,900	Electric Construction, Limited, Nos. 101 to 45,100	10	1½ — 2	1½ — 1⅝	1⅝	1 9/16
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	... ...	... ...	...	...
100,000	Elmore's French Patent Copper Depositing Co., Ltd, Nos. 1 to 66,750	2	⅛ — ¼	⅛ — ¼	...	...
91,195	Elmore's Patent Copper Depositing, Limited., Nos. 1 to 70,000 ...	2	¼ — ⅜	¼ — ⅜	...	...
67,385	Elmore's Wire Mfg., Ltd., Nos. 1 to 67,385, issued at 1 p.m., all pd.	2	⅜ — ⅝	⅜ — ⅝	...	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300 ... (£4 10s. only paid)	5	1 — 2	1 — 2	...	...
180,227	Globe Telegraph and Trust, Limited	10	9⅜ — 9⅞	9⅜ — 9⅞	9 15/16	9⅜
180,042	Do. do. 6 p. c Preference	10	14⅞ — 15⅛	15 — 15¼	15¼	14⅞
150,000	Great Northern Tel. Company of Copenhagen	10	19½ — 20	19½ — 20	...	...
200,000*l*	Do. do. 5 p. c. Debs. (issue of 1883) ...	100	105 —108	105 —108	...	...
12,134*l*	Greenwood and Batley, Ltd., Ordinary, Nos. 4667 to 14,000 ...	10	4½ — 5½	4½ — 5½	...	...
9,600*l*	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	6 — 7	6 — 7	...	...
50,000	India-Rubber, Gutta Percha and Telegraph Works, Limited ..	10	21⅛ — 22½	21½ — 22½	22⅛	21⅝
200,000*l*	Do. do. 4½ p. c., Deb., 1896	100	102 —104	102 —104	...	...
17,000	Indo-European Telegraph, Limited	25	39 — 42	39 — 42	...	...
11,334	International Okonite, Ltd., Ordinary Nos. 22,667 to 34,000	10	1½ — 2½	1½ — 2½	...	...
30,000	†Liverpool Electric Supply, £3 10s. paid	5	4 5/16 — 4 7/16	4 5/16 — 4 7/16	4 7/16	4 5/16
10,000	Do. do. fully paid	5	6¼ — 6⅜	6¼ — 6⅜	6⅜	6¼
37,548	London Platino-Brazilian Telegraph, Limited	10	4 — 6	4 — 6	...	...
100,000*l*	Do. do. do. 6 p. c. Debentures	100	107 —110	107 —110	...	...
49,900	*Metropolitan Electric Supply, Ltd., Nos. 6,101 to 50,000 (£9 paid)	10	5⅝ — 6¼	5⅝ — 6¼	6¼	6
50,000*l*	Do. 5 p.c. debentures, 1 to 5,000 in bonds of £10, £20, £40	...	102 —105	102 —105	...	...
15,000	Monte Video Telephone Co., Ord., Nos. 1 to 15,000 fully paid ...	5	1½ — 2½	1½ — 2½	...	...
28,000	Do. do. 6 p. c. Pref., Nos. 1 to 28,000 fully paid	5	3 — 4	3 — 4	...	...
458,867	National Telephone, Limited, Nos. 1. to 438,984	5	4⅜ — 4⅝	4⅜ — 4⅝	4⅝	4 7/16
15,000	Do. 6 p. c. Cum., 1st Preference	10	14½ — 15½	14½ — 15½	...	...
15,000	Do. 6. p. c. Cum. 2nd Preference	10	14 — 14½	14 — 15	...	...
90,950	Do. 5 p. c. Non-cum. 3rd Pref., Nos. 1 to 90,950 ...	5	5¼ — 5⅜	5¼ — 5½	5⅜	5 5/16
726,477*l*	Do. 4½ p.c. Deb. Stock Prov. Certs. fully paid ...	...	111 —113	111 —113	112¼	...
48,800*l*	New Telephone, Limited, Nos. 25,901 to 74,700 ... (£2 paid)	10	... ...	... ...	...	...
6,451	Notting Hill Electric Lighting Company, Limited, fully paid ...	10	5 — 6	5 — 6	...	...
220,000	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11s. only paid)	1	3/16 — 5/16	3/16 — 5/16	...	...
100,000*l*	Pacific and European Tel., Ltd., 4 p. c. Guar. Debs., Nos. 1 to 1,000	100	100 —103	100 —103	...	...
11,802	Reuter's Limited	8	4½ — 5½	4½ — 5½	5	...
18,680	St. James's & Pall Mall Electric Light Co., Ltd., Ord., 101—18,780	5	6⅛ — 6⅜	6⅛ — 6⅜	...	...
20,000	Do. do. 7 per cent. pref., Nos. 20,081 to 40,080	5	7⅞ — 8⅛	7⅞ — 8⅛	...	...
3,381	Submarine Cables Trust	Cert.	115 —120	115 —120	118½	...
78,949	Swan United Electric Light, Limited ... ... (£3½ only paid)	5	2 — 2⅛	2 — 2⅛	2	...
37,350	Telegraph Construction and Maintenance, Limited	12	33 — 35	33 — 35	34⅞	34⅜
150,000*l*	Do do. do. 5 p. c. Bonds, red. 1894	100	101 —104	101 —104	101½	...
58,000	United River Plate Telephone, Limited	5	2 — 2⅛	2 — 2⅛	...	...
146,370*l*	Do. do. 5 p. c. Debenture Stock	Stock	90 —100	90 — 100	...	...
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	5½ — 6½	5½ — 6½	...	...
260,900*l*	Do. do. do. 5 p. c. Debentures	100	99 —102	99 —102	...	...
30,000	West Coast of America Telegraph, Limited	10	2½ — 3½	2 — 3	2 1/16	...
150,000*l*	Do. do. do. 8 p. c. Debs., repayable 1902 ...	100	97 —101	97 —101	...	...
64,242	Western and Brazilian Telegraph, Limited	15	6½ — 6⅝	6½ — 6⅝	6⅝	6⅝
33,129	Do. do. do. 5 p. c. Cum. Preferred	7½	5⅝ — 6½	5½ — 6½	...	...
33,129	Do. do. do. 5 p. c. Deferred	7½	1½ — 1⅝	1½ — 1⅝	...	...
178,200*l*	Do. do. do. 6 p. c. Debentures "A," 1910 ...	100	103 —106	103 —106	...	...
222,700*l*	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	103 —106	103 —106	...	..
88,321	West India and Panama Telegraph, Limited	10	1 — 1¼	1 — 1¼	1⅛	...
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	10½ — 10⅝	10½ — 10⅝	10⅝	10½
4,669	Do. do do. 6 p. c. 2nd Preference ...	10	9 — 10	9 —10	...	...
80,000*l*	Do. do. 5 per cent debentures (1917) No. 1 to 1,000	100	105 —108	105 —108	108	...
$1,214,000	Western Union of U.S. Tel., 7 p. c. 1st Mortgage (Building) Bonds	$1,000	120 —125	120 —125	...	...
169,000*l*	Do. do. 6 p. c. Sterling Bonds	100	101 —104	101 —104	102	...
59,900	*Westminster Electric Supply Corp., Ord., Nos. 101 to 42,953 ...	5	5 — 5⅛	5 — 5⅛	...	...

* Subject to Founders' Shares. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED:—Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 5⅛—6.—Brush Company 4½ per cent. Debenture stock, issued at 1 per cent. premium, 100—103.—Electric and General Investment, shares of £5 (£1 paid), 1⅝—2⅛.—Founders' shares, 200—225.—House to House Company (£5 paid) 1¼—2¼.—Do. 7 per cent. Preference of £5, 5—5¼.—Do. 6 per cent. Debentures of £100, 97—102.—Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid), 5⅛—5⅜. 1st Preference Cumulative 6 per cent., £5 (fully paid) 6—6¼.—Manchester, Edison and Swan Company, 19 (£1 paid). ⅜—½.—Queen Anne's Mansions Lighting and Heating 6 per cent. £10 Debentures, 101—103.

Bank rate of discount, 4 per cent. (August 10th, 1893).

THE FAKIR'S SILVER TONGUE.

NO WONDER THE FASCINATED FARMERS BOUGHT HIS ELECTRIC BELTS.

THERE are some delights vouchsafed the inhabitants of villages and small towns that the metropolitan resident knows not of, and not the least of these is the sweet singer of curealls, the night hawk of universal panacea. He must not be confused with the small and base imitator of the metropolis who vends a corn salve on a Bowery or other populous corner until an unsympathetic police officer orders him to move on. This delight of the villager is mounted high upon an imposing platform, lighted by flaming torches, and attended by a musician, sometimes a whole band of them. In fact, he makes an obstruction for which there is no tolerance in the streets of the metropolis.

One of the dearest of his kind was observed in a New Jersey town recently by a *Sun* man. The fakir was selling an "electric" belt, which was guaranteed to cure anything from that tired feeling to homicidal tendencies. His attendant, a banjoist, for diversion and general utility man when required, was a bright, but hard-faced young man, whom the "Doctor" referred to as "Professor," but confidentially addressed as "Tom." The fakir's stand was built in the centre of a large open lot on the outskirts of the town, and the lot, soon after dark, was well filled with a crowd of men who made a curious mixture of mill hands and small farmers, their wives, sweethearts, and children. The Doctor, it was easy to see, was esteemed by his audience a great and wise man, and the Professor, especially when he played his banjo and sang, was adored by the women and children. The Doctor was a glib-tongued Yankee, with an Uncle Sam cut of beard and a silk hat having the flat brim affected by the Paris art students, but which the doctor had evidently worn since its really fashionable days.

His first care was to convince his hearers that all of them were afflicted with ailments which his belt was peculiarly designed to cure. It was amazing how easy a thing it seemed to be to convince those people they were all invalids. "Woe betide the man or woman, I say," shouted the fakir, "who, proud in the strength of his youthful beauty, madam, defies the ravages of the worm that stingeth like an adder, as the good Book says, well knowing as I do that there be those who in their sinfulness and pride, which cometh in the fall, deems himself superior to religion, and though his Christianity teaches him he is sick, yet will he defy the germs lurking in the very air we breathe, the water we drink!"

That was convincing, and realising that he might strengthen his effect with a touch of sentiment, the doctor turned to his assistant and said: "The Professor will now oblige us by singing a few verses of that beautiful melody, 'Golden were her tresses, but we laid our child away.'" And the Professor did sing several verses in a voice not at all bad, considering that it was nightly called upon to fill all outdoors.

While the Professor was singing, accompanying himself on a banjo, the Doctor was setting up in a small trunk a small electric battery which he attached by wires to a couple of pieces of metal sunk in what he said had been a belt. When the song was sung the Doctor held up his piece of belt and said:

"Now, ladies and gents, it ain't no use my spoiling a new belt every time I produce this wonderful, this marvellous experience in the beautiful science of electro-magnetism, which is why I use this old belt over again, for, as the prophet wisely says, a stitch in time saves a penny. Now, if two gentlemen will step upon the stand I will show the assembled multitude what I mean when I say that this belt which I offer to you this evening is indeed the nineteenth wonder of the age, absorbing as it does the effluvia of such microbes as beset humanity, which is poor at best, and by the alternating process discovered by Mr. Morse, so reviving the most exhausted in mind and body that the blind may see and the halt may cast their crutches at the thieves in the temple, removing at the same time all beams from the eye. Will two gentlemen step forward?"

After much urging and bashful hesitation two men did step upon the stand. One was a man from the iron mills, a lusty, big fellow, beneath whom the stage creaked; the other, a farmer's son, gawky, strapping, blinking. They were both greeted by name by the delighted crowd, and advised not to be afraid.

"Now if you two gents will place your hands on these pieces of metal I will produce a sensation which you, describing to your friends in the multitude, will convince them more than any word of mine that what I say of my anti-microbe belt is the welcome truth for which their disease-racked bodies have long been a-thirst. For what is it the Bard of Avondale says?—

> Hung be the heavens with black!
> A man's a man for all of that,
> Withered limbs and aching back,
> Bubble, bubble, there's the trouble!

"Surely a man cannot deny an old master, and if the divine William was not an old master, why, as the member of the House of Lords said when he'd been drinking too much tea in the Tower of London: 'Where is my 'at?' Now, Professor, if we are all ready, give the gentlemen a gentle shock."

The crowd became very quiet; the men stood, looking very foolish, their big hands on the metal discs, but there was something wrong with the battery. The reporter walked round to the rear of the stand to see if he could make out what the trouble was.

"The Professor," continued the fakir, sparring for time, "has to adjust to a nice equilabarium the delicate electrodes which represent at one and the same time the moisture of the body and the perspiration of the skin."

Then aside: "Can't you make the darn old thing go, Tom?"

"No; there's something missing yet, but I don't know what it is," answered Tom.

"The Professor informs me," shouted the Doctor, "that the negative jar indicates a feverish tendency in what we medical men term the sanguine pulsations of this gent here," putting his hand on the shoulder of the young farmer, who was as red as a boiled lobster, and dripping with perspiration. "Am I right in my dagnostics, sir? Are you warm?"

"You bet I be," blurted the subject, and the Doctor had scored a point, but the electric current would not start.

"That being the case, I must assist the Professor in his adjustments."

He leaned over Tom and whispered: "Never mind the dog gasted thing; I'll go on with the talk, and when I give you the tip jab a needle in the hobos' legs. They're so flabergasted they'll think it's a shock."

Then he faced the crowd and continued: "We have fixed the adjustment so that the polarisation should combine the circuit in a brief minute. In the meantime let us be patient, for as the brave mariner takes the altitude of his ship by the polar star, what would become of us if he were impatient?"

Tom had moved behind the "hobos." The doctor suddenly threw his hands in the air, a trick to attract the attention of any who might be looking at Tom, and shouted: "I should judge by this time the circuit is complete."

Both the men jumped in the air and howled. There was a sensation in the crowd.

"Did you feel a shock? You should have felt it in your legs," observed the fakir, addressing the victims. They both answered satisfactorily by rubbing their legs.

"It is indeed marvellous, marvellous!" exclaimed the fakir, taking a bundle of the belts and handing one down to a man who passed up a bill.

"Electricity is light, it is fire; and does not our classics teach us that when the foolish maidens of Ireland let their lamps of fire go out they were dashed over the cliff dwellers? Think of it! A hundred years ago a king could not buy a match with all his wealth, but now any one of you can buy one of these belts, the fire of life, as has just been attested by your friends, for two dollars."

He was selling them fast now.

"Surely, while there is fire there is hope, and no longer need we leave undone those things which we ought to have done, for there is health in us."

And so he rattled on until the ultimate customer had been captured, and then the people slowly went away.

"What made those hobos jump so, Tom?" asked the Doctor of the Professor as they were packing their trunk.

"I didn't have a needle, so I had to jab 'em with a knife," answered Tom.—*New York Sun.*

REVIEW.

A Handbook on the Steam Engine. By HAEDER AND POWLES. London: Crosby, Lockwood & Son.

This book is an English translation by Mr. H. H. P. Powles, of a German work by Mr. Herman Haeder, civil engineer, of Duisburg. According to the author's preface, "the work aims at showing the results of practical experience," and accordingly we find that a great part of the book is taken up with tables giving details of the sizes of the various parts of engines illustrated in the book. These illustrations are very numerous and for the most part well executed, and with the additional examples furnished by the translator, engines by well-known British makers serve as a means of comparing the best and most modern continental practice with our own. But having said that about this portion of the work, no more can be said in commendation. It looks as if the author had collected a number of the various maker's catalogues, and had then used paste and scissors somewhat too freely.

We are pleased to see that, on the ancient history of the steam engine, the author is most admirably brief and succinct; but we are astonished to find that the translator has allowed the Englishman Trevithick's name to appear as "Trevitick," and still more that he has permitted the unwarrantable Teutonising of the Clyde engineer, John Elder, into "John Edler." A good many instances of slipshod and faulty English appear throughout the work, and in some cases the punctuation is so bad as to be often misleading.

Perhaps the best portions are Sections III., IV., and IX. Section III. deals very fully with various types of governors and gives numerous illustrations. Formulæ are also given which, however, are not likely to be much used. The succeeding section goes into the matter of valves and valve gears, with a fulness which we did not look for in such a work. After a description of the usual forms of slide valves, there follows a full and well illustrated list of a great many forms of valve gear in common use, such as Corliss', Rider's, Meyer's, Proell's, König's, and several other types, well-known in this country and on the continent. Along with this are given a good account of Zenner's method of constructing valve diagrams, and a well-written section on such like motion and other reversing gears, as Stephenson's, Gooch's, and Allan's. On the whole this is the most important section of the book. Section IX., on the indicator, will be perused with much interest, though the most of the drawings are too small to be of real value.

We question very much if this work will be of service to young students as a text book, partly on account of its treatment of the subject, and partly on account of the peculiar arrangement of the matter. As a book of tables for handy reference, and possibly, also, as an advanced mechanical drawing book, it will doubtless be of use to those whose experience or reliance on their own abilities is limited.

The book is well printed and bound, and possesses a good and carefully compiled index. Its title is, however, slightly misleading. "The Anatomy of the Steam Engine" would more correctly describe the contents.

"Re-dressing" Alternating Currents.—The New York *Electrical World* gives a short abstract of a paper read before the French Academy of Sciences by M. Pollak, in which an apparatus is described which re-dresses an alternating current, and gives as a result a pulsating direct current, which never falls below a certain adjustable minimum value. A commutator having wedge-shaped bars, the points all being in the same direction, is used. The brushes are moved parallel to the axis in one direction or the other until such a point is reached that the voltage of the re-dressed current is exactly equal to the counter E.M.F. of the rest of the circuit (which may be accumulators) at the moment of breaking; all sparking is thereby avoided.

THE OCONTO INCANDESCENT LAMP CASE.

ANOTHER important lamp case is now being tried in America. The circumstances which have brought it on are briefly these:—The Electric Manufacturing Company, of Oconto, Wis., is one of those lamp manufacturing concerns that had to close its doors at the instance of the General Electric Company, prior to the hearing of the Columbia case. Since that case was heard it occurred to the defendant company to apply for a modification of its restraining order, so as to enable it to continue the manufacture of incandescent lamps, pending the final hearing of the Columbia case. Notice was consequently served upon the complainants to this effect on May 13th, 1893, and after several postponements the case at length came on for hearing, before Judge Seaman, at Milwaukee, on July 3rd. The counsel representing the respective parties were nearly the same as in the preceding cases at Boston and St. Louis.

The evidence used was the now familiar Goebel story, but the feature constituting the point of especial interest in the present trial is the introduction of a considerable amount of new evidence by the plaintiffs. In both the former cases where the story was used, the attack made by the complainants, as to its truth, was of a very feeble nature, the principal arguments used being mere deductions and analogies. The new evidence, however, attacks the story in its vital parts by declaring proof that the Goebel lamp exhibits, 1, 2 and 3, were recently made by Henry Goebel, Jun., and it is admitted by the defendants, that provided this evidence is correct their case is gone. This new evidence is rebutted by deposition only, and no additional evidence is furnished by the defendants.

The new evidence introduced by the complainants' affidavits is to the effect that the Goebel lamps, 1, 2, and 3, were made in September, 1892, by H. Goebel, Jun., three or four witnesses supporting this evidence. As to lamp No. 4, this and other similar lamps were made by the glass-blower, Hager, when working with Goebel in the early '80's, and the fact is testified to by the affidavits of Hoffman and Hager. As to the bamboo plainer, exhibit No. 6, that was made as late as 1883, having been made by Korwan, and Korwan's statement is corroborated by Hager and Fitzpatric. In addition to the above, several of the affidavits put in by the defendants are discredited.

At the opening of the case the defendants asked leave to amend their answer in consequence of certain developments that had arisen through the Columbia case, and after some dispute the amended answer was admitted.

Mr. Dyer then commenced his argument for the plaintiffs. Referring to the new evidence, he said fraud was established in that all the lamps were made subsequent to Edison's patent. He pointed out how, in the previous cases, the defendants had introduced fresh affidavits to fill up gaps in the story. Referring more particularly to the affidavits proving fraud, A. F. Hager, the glass-blower, said that one day in August or September, 1892, Henry Goebel, Jun., called at Demuth's house, at which the former was employed, and asked to buy a piece of glass tubing to make some lamps. "I picked out a piece from stock," says the affidavit. "It was about 3 feet long and about 1 inch in diameter. He asked me to draw the end out and said that he wanted to make some lamps. . . . I then took the tube upstairs to my bench and drew out the end in a stem several inches long. He (Goebel, Jun.) said that he could then go on and make the lamps himself . . . He then took me out to a saloon on the next corner, where we talked the thing over. He said that the lamps he was going to make were for a case, meaning a law case in court, and that there would be something in it for me later on, and that he would see me again. . . .

"Some time after the above took place, and in January of this year, Henry Goebel, Jr., came to Demuth's shop again and asked me to help him out by making an affidavit in this case. He referred to the same law case which he had talked about at the previous interview. He asked me to go to Willer and Kenyon's law office, and to make an affidavit. I did so, and my affidavit was in what was called the Beacon case, and is dated January 26th, 1893, which, I believe, was the date when this call at Willer and Kenyon's office took place."

(Hager made two affidavits, the one referred to and another on March 1st. In the former, he testifies to Henry Goebel's skill in the manufacture of making carbons, to his skill as a glass-blower, to his having had a mercury pump about 1881, which was used for exhausting lamp bulbs; also to his having seen at the time a number of old lamps in a safe, amongst them being some fiddlebow lamps, and which Goebel had told him he made himself. His second affidavit was in regard to the character of Albert Helschell.)

The new affidavit continues: "While we were together at that time he told me that he had made three lamps out of the tubing which he had bought at Demuth's, the end of which I had drawn out in a stem for him, as I have stated, and that they were to be used in that case, meaning the Beacon case.

"These three lamps which Henry Goebel, Jun., said he made, as I have just stated, I never saw; but he told me that he had made them to go into the case in which I had made my affidavit—the Beacon case—and that they were to be used in that case. He did not say what use was to be made of them, and I had no means of knowing."

The affidavit proceeds to say that the lamp exhibits, 1, 2, and 3, could have been made out of the piece of tubing he sold to H. Goebel, Jr., being of the same diameter.

"As regards lamp No. 4, on this photograph, it looks exactly like lamps which I made myself early in the eighties, when I was employed by the American Company and worked at Henry Goebel's shop, at No. 468, Grand Street, as I have stated. I then made for him, while at his shop, lamps like this exhibit lamp No. 4. Those that I made had carbons of the hairpin shape, like this exhibit, and had leading-in wires sealed into the sides. It really seems to me as if I must have made this very lamp, judging from the photograph, but I am not certain of it." (The evidence here given would have

had greater weight had Hager not sworn to a very different story at a time when, no doubt, it appeared to be to his interest to do so. But his last affidavit is corroborated by others who have not previously given evidence, and thus the new version receives support.)

Mr. C. F. Cozzin, a contractor, in whose employ Henry Goebel, Jr., was, for about a year, prior to September, 1892, testifies as follows: "A few days before Henry Goebel, Jr., left me, as I have stated, he came into the shop with a hand-bag or gripsack. He opened it and showed me three lamps of tubular shape and a pair of flat pliers. I am now shown a photograph which I am told represents Goebel lamp exhibits, 1, 2, and 3, in the Beacon case. I believe that the lamps which were in Goebel's bag were these lamps. Certainly these lamps in the photograph look exactly like the lamps which were in the bag. When he showed me these lamps, I asked him what he was doing. He said he had been making those lamps. He said it in such a way that it aroused suspicion in my mind, and I said to him, that those pliers were a dead give-away. He said nothing, but he smiled in such a way which satisfied me just what he was doing, which was, as I thought, that he had made those lamps for use in the Edison and Goebel law case; he was helping Mr. Bull on." This witness proceeded to say that every time he saw Goebel, Jr., after he first saw Mr. Bull, he showed him money he had received, which money Goebel said he had made since he went out.

Max Hoffman, a saloon keeper, knew Henry Goebel, Jun., and frequently talked with him over his business affairs, including the Goebel lamp case. He says that, after having read Judge Colt's decision, he remarked one day to Goebel, Jun.: "Henry, I see that you lost your case in Boston," to which he replied: "I know that, Max, but how did you know it?" Hoffman replied: "Here is a paper telling all about it." He read it him, and, as he got to where the judge stated that the lamp No. 4 made him doubt the whole story about the lamps, Goebel, Jun., interrupted him with: "That is a nice kind of judge? If he had dropped on lamps, 1, 2, and 3, instead of 4, he would have come nearer to hitting the nail on the head. Max, you remember the day I gave you the wire for your dog chain? That is the day I made those lamps. No. 4, was made back in 1883, by one of the men that worked in my father's shop in Grand Street."

F. Korwan deposed to having been foreman of the tool department of R. Hoe & Co. for 30 years. He had known Goebel for many years past, and, in 1883, frequently visited him at No. 468. He was then making incandescent lamps and cutting the wood for the carbons, by hand, one at a time, with a knife. That was too slow, and Goebel got a machine to do the work quicker, and this machine was cast in Hoe's shops about 1883. Prior to this machine he had seen no machine, and if one had existed he must have known it, as he visited the place often. Shown a figure of the exhibit, he said it was like the one made for Goebel—is sure it is the same.

F. Fitzpatric made an affidavit for the Columbia case to the effect that formerly he was in the employ of C. E. Perley & Sons, ship mechanists, and that between 1850 and 1864 he did a good many odd jobs for him, amongst which, he thought, was the cast used in exhibit 6. He was not quite certain, however. He did no work for Goebel after 1864. This same witness now makes a second affidavit to the effect that his recollection of dates is very imperfect. He does not recall making any casting for Goebel. He only remembers repairing stoves for him. He continues: "When I made my former affidavit, herein referred to, I did not, and could not, recognise or identify the machine or apparatus, Goebel exhibit No. 6, or any part thereof. I have no recollection that I ever cast Goebel exhibit No. 6, and I so informed the gentleman who secured from me my former affidavit of February 7th, 1893.

Max Schumann, a book-keeper for Demuth Brothers, testifies to Goebel, Jr., having bought the tubing, and to Heger having taken it upstairs to draw it out.

Affidavits were next introduced of witnesses who, in the prior cases, had testified to having seen Goebel's lamps working, and so-forth, and who now withdrew their former statements, among the more important being those of Miss A. Rice, and Herman Kraft.

Mr. Dyer, continuing his argument, remarked on the fact that the defendants' council had not thought fit to place Henry Goebel in the witness box, indicating thereby a lack of confidence in their own witness. In regard to lamps 1, 2 and 3, Goebel said they had been kept uninjured for 40 years, but they cracked while bringing them from somewhere to the lawyer's (Bull's) office. Glass-blowers said that they must have cracked within a few hours of the time they were made. In the case of lamp No. 4, the defendants' counsel in the Beacon case at first admitted that they regarded it as fraudulent, but when they saw that to gain their case that lamp was a necessity, their suspicions disappeared. Judge Colt expressed his opinion as regards the non-genuine character of that lamp in very decided terms.

After the noon recess, a sensational episode occurred over Mr. Bull's day book, which the plaintiffs' asked to inspect. Part of this book has been in evidence and part suppressed, and plaintiffs' believed that it contains other entries which would throw new light on some of Mr. Bull's testimony. Mr. Witter replied to the effect that the gist of the complainants' attack was that lamps, 1, 2 and 3, were made by Goebel, Jun., in 1892. Mr. Bull, however, saw these lamps in 1890 and in November of that year, made sketches of them. The plaintiffs put these in evidence, not the defendants. The plaintiffs' game was delay; they spent the whole night until 3 a.m. trying to get the Westinghouse Company to sell itself. Fraud and bribery lay with them. His Honour might see the book, but these people, with unclean hands, should not see the book with his consent. The whole question was, were these lamps, 1, 2 and 3, made in 1892, or were they made before? Anything his Honour could find relating to the date, he was willing that they should see. Eventually Mr. Bull's brother was assigned the duty of copying out anything in the book relating to the Goebel matter to be submitted to counsel.

Mr. Dyer, continuing his argument, next dwelt on the history of incandescent lamps, then compared the Drawbaugh case with the present one, and discussed, at some length, the unreliability of Goebel. Goebel had falsified the case not once, but many times. His dealings with other men in relation to his inventions show him to be untruthful. The criticism brought against lamps 1, 2 and 3, that iron and copper wires were unsuitable for leading-in wires was answered by Goebel by saying that he covered the iron wires with borax—with liquid rubber, &c. — forgetting that in his first affidavit he stated that "the metallic wires were fused directly into the glass, no cement or other substance being used." Another significant point was, that subsequent to Edison's patent, Goebel had applied for patents on some minor details of lamp construction, one of which was for a spiral form of spiral leading-in wire. The patent was not granted at first in consequence of Edison's patent and had to be altered. Lamps 1, 2, and 3 contained this spiral feature, and Goebel claims to have made them in 1854. Had he been first to invent this feature he would not have submitted to interference from Edison's patent. By applying for a patent in 1882 for a device invented in 1854, he was practising fraud upon Government.

Amongst other more important points that were made, was one in connection with lamp No. 4. In the Beacon trial it had been asserted that this lamp had only been in Mr. Bull's possession a few days before the trial, and that was the reason it was not put in at first. It had now been proved that this lamp had been in Mr. Bull's possession since October, 1892, when Goebel, Jun., was taken into his employ, and that it had been received about the same time as lamps 1, 2, and 3.

The complainants' case is undoubtedly a powerful one, and far stronger than those previously presented. But it unfortunately hangs very largely upon mere verbal statement, just as the defence does, and, with shame be it said, the love of truth does not dwell in all men. One consideration that weakens the complainants' case rather materially is the fact that their new witnesses did not come forward in the Columbia. case. Max Hoffman, the saloon keeper, for example, cannot claim ignorance as a pretext for not coming forward long ago to declare what he knew in the matter; and no doubt C. F. Cozzin was similarly circumstanced in point of knowledge of the fraud in dispute; Hager's integrity need not be considered. The question of voluntarily disclosing truth and showing up a wrong is one that every individual has to consider to some extent through life, and it is a moot point, perhaps, to what extent we are morally constrained to carry out the principle. No doubt the necessity varies with the circumstances of each case, but in a widely known and heated dispute, it is surely incumbent on every one who may be in a position to elicit truth to do what he can in the matter without delay.

ELECTRO-CHEMICAL EFFECTS ON MAGNETISING IRON.*

BY THOMAS ANDREWS, F.R.S.

IN the experiments a pair of bars (one long and the other short) were immersed in solution in a U-tube, in circuit also with a delicate galvanometer, and after a suitable time had elapsed in every case for normal galvanic equilibrium to obtain, the longer of the bars was magnetised by means of a coil into which the upper end projected, and the magneto-chemical effect recorded. It was found to vary with the nature of the metal and solution employed, and also with the extent of the magnetic saturation of the metals. The strength of the magnetism was practically the same in many of the experiments, and it was generally observed that difference in the strength of the solutions affected the results. In other experiments with a uniform strength of solution, but in which the magnetism of the metals was varied or reduced, the magneto-chemical effect became proportionately altered.

Hydrochloric Acid, conc., sp. gr. 1·16.—No perceptible electro-chemical effect was obtainable with this reagent.

Bromine and Potassium Bromide.—The magneto-chemical effect was very great with this reagent, the E.M.F. between the magnetised and unmagnetised bars sometimes reaching as high as one-twentieth of a volt. The highest E.M.F. appeared to be manifested at or near the time of the energetic effervescing attack on the metal; though the E.M.F. between the bars was always considerable from the earliest commencement of the magnetisation of the bar in the coil. Experiments were made on both wrought-iron and steel bars.

Ferric Chloride and Chlorine Water.—This solution consisted of 250 fluid grains of a concentrated solution of $Fe_2 Cl_3$ and 750 fluid grains of saturated chlorine water. In these experiments the electro-negative position assumed by the magnetised bar formed an exception to the general rule, which, I think, may probably to some extent be explained on the supposition of the diamagnetic properties of the dissolved chlorine; the magnetised bar being somewhat less attacked by the free chlorine than the unmagnetised rod. When the chlorine had exhausted its action on the metal, the electro-chemical reaction became gradually reversed, and the magnetised bar then assumed the electro-positive position, as in the case of normal ferric chloride solution only. To show that the above negative effect was due only to magnetic influence, various experiments with $Fe_2 Cl_3$ and chlorine water were made, in which it was found that on ceasing to magnetise the bar for a few moments, the E.M.F. decreased, and the magnetised bar assumed a less negative position, but on again connecting the

* Abstract of paper read before the Royal Society.

battery to the coil, the magnetised bar therein assumed a more electro-negative position.

Nitric Acid, sp. gr. 1·42, *and Potassium Chlorate.*—These experiments, made with solutions containing varied proportions of HNO_3 and K_2ClO_3, indicate that these magneto-chemical effects are greater in stronger solutions. On ceasing to magnetise the bar, in course of any of these experiments, the needle of the galvanometer fell to zero, and on remagnetising the bar its electro-positive position was re-asserted.

Ferrous Sulphate.—A saturated solution of the salt. The observations indicated that the results were influenced by the extent to which the metal was magnetised; the latter fact was more distinctly shown in course of experiments with bromine and the salts of copper.

Ferric Chloride.—A saturated solution of the salt in water. On ceasing to magnetise a bar in this reagent, the E.M.F. steadily diminished, and on again applying magnetisation the magnetised bar resumed its positivity. At the end of forty hours there was a perceptibly greater deposit of flocculent oxide of iron in the tube containing the magnetised bar.

Cupric Chloride.— Consisted of a concentrated solution of the salt in water, such as is usually employed in dissolving out the metallic iron in the carbon determination of iron analyses. The magneto-chemical effect with this reagent was of considerable magnitude, a powerful effect commencing from first magnetisation of the bar, and largely though steadily increasing. On ceasing to magnetise the bar, the galvanometer deflections were reduced; but on again bringing the magnetising coil into action, the magnetised bar steadily re-asserted its strong positive position in course of a few moments. These magnetic effects were not of such a nature as to produce a very violent fling of the galvanometer, but manifested a steady and permanent character, though in most instances deflections commenced at once on magnetising the bar, and afterwards continued steadily to increase till the maximum point was reached. On the completion of an experiment, both bars were of course covered with electro-deposited metallic copper; but in many instances the colour of the solution in the limb of the U-tube which had contained the magnetised bar, was of a rather lighter tint, showing that a somewhat greater deposition of copper had occurred therein. The E.M.F. was greater in the case of wrought-iron than with steel bars.

Cupric Sulphate.—A concentrated solution of the salt in water. The remarks made on the magneto-chemical effects with cupric chloride apply generally to the reactions obtained with cupric sulphate, but the effect was more extensive when employing the latter salt.

Cupric Nitrate.—Was composed of a saturated solution of the salt in water. The magneto-chemical effect was observed with this reagent, though it was more limited in extent than when using either CuCl, CuBr, or $CuSO_4$.

Cupric Acetate.—This was a concentrated solution of the salt in which the effect was small; but it was distinctly noticeable.

Cupric Bromide.—Consisted of a saturated solution of the salt in water. Highly interesting and very marked results were noticed in the experiments with this reagent. The electro-positive position of the coil-bar was dependent on the extent of its magnetisation, in these as in the other experiments, and the effects with cupric bromide were generally similar to those obtained with cupric chloride.

Sulphate of Iron.—A pair of steel bars were left in a yellow oxidised solution of sulphate of iron for 24 hours, the bar having been magnetised for a short time at commencement only, the residual magnetism being allowed to complete the effect; an E.M.F. of 0·011 volt was gradually reached, the magnet bar being in the positive position.

The Electro-Chemical Effect as between the Magnetic Polar Terminals and Equator.

It seemed probable that the effect might possibly be connected with the local currents which are shown below to develop in a magnetised bar between the more highly and less magnetised parts thereof, when the rod was immersed in suitable solutions acting chemically upon it, and experiments demonstrated the interesting fact, that when a magnetised bar is thus immersed a local galvanic current is set up between the polar termiuals and central equator or less magnetised portion of the bar, the more magnetically-neutral zones acting electro-negatively in relation to the poles. Under these induced conditions it becomes obvious that a magnetised bar, forming one element of a galvanic couple, would be more acted upon than an unmagnetised one, forming the other element in the same solution. Hence, one explanation is afforded of the electro-chemical positive position generally manifested by the magnetised bar in course of the research.

NEW PATENTS—1893.

15,110. "Improvements in apparatus and devices for starting, stopping, and reversing electromotors." F. A. PERRET. Dated August 8th. (*Complete.*)

15,151. "Improvements in circuit-testing apparatus." F. S. PALMER. Dated August 8th. (*Complete.*)

15,156. "Improvements relating to telephones." P. RABBIDGE. Dated August 8th.

15,198. "Improvements in apparatus for obtaining ignition by means of electricity." L. B. MILLER and M. W. WOODS. Dated August 9th.

15,217. "Improvements in electric cables." G. C. DYMOND. Dated August 9th.

15,231. "Improvements in electric arc lamps." A. J. BOULT. (Communicated by A. Bureau, Belgium.) Dated August 9th.

15,246. "Improvements in or connected with the application of motive power to turbines." H. HOBSON. Dated August 10th.

15,248. "Improvements in joints for electric light, gas, water, and other similar fittings." E. A. CLAREMONT. Dated August 10th.

15,257. "Improvements in and connected with galvanic batteries." S. MARCUS. Dated August 10th. (*Complete.*)

15,264. "Improvements in plating metallic surfaces and also prepared surfaces of non-conducting substances by electro-chemical deposition." P. MARINO. Dated August 10th. (*Complete.*)

15,284. "An improved safety device for facilitating the replacing or removing of electric fuses." D. F. ADAMSON. Dated August 11th.

15,322. "Improvements in instruments for telephonic and telegraphic transmission of speech or sounds." A. T. COLLIER. Dated August 11th.

15,337. "Improvements relating to electric arc lamps." E. D. TRESEL. Dated August 11th.

15,338. "Improvements in cases for electric bell mechanism." L. BOURGEOIS. Dated August 11th.

15,343. "Improvements in and relating to the attachment of electric lamps to their posts." W. OSENBERG. Dated August 11th. (*Complete.*)

15,355. "An improved electric battery." H. S. PYNE and R. THOMPSON. Dated August 12th.

15,366. "Improvements in electrical heating and cooking apparatus." G. A. J. SCHOTT, G. A. SCHOTT, and G. G. SCHOTT. Dated August 12th.

15,373. "Electric light fixtures." F. W. DAVENPORT. Dated August 12th. (*Complete.*) [Date applied for under Patents, &c., Act, 1883, Section 103, January 16th, 1893, being date of application in United States.]

15,396. "Improvements in or connected with apparatus for the manufacture of chlorate of potash by electrolysis." F. HURTER. Dated August 12th.

15,406. "A new or improved 'cut-out' to be employed in connection with electric arc lamps." W. H. AKESTER and THE AKESTER ELECTRIC SYNDICATE, LIMITED. Dated August 12th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1892.

37. "Improvements in electric tricycles and cars actuated by electricity." W. W. G. WEBB. Dated January 1st. Relates to the various parts, switches, gearing, &c., of an electric tricycle or car driven by accumulators.

1,626. "An improvement or improvements in the holders or carriers of electrical incandescent or glow lamps." R. G. EVERED. Dated January 27th. The inventor employs a china or other insulator of a size and shape suited to fit the liner. The said insulator has two parallel holes in which the spring pins are situated, and as the said insulator surrounds the greater part of the said spring pins and fills the greater part of the liner the said spring pins are not only effectually insulated from each other, but also from the liner, and short-circuiting is prevented. 3 claims.

11,320. "Improvements in telephonic apparatus." C. VOGT. Dated June 16th. Has for its object to adjust the poles of a telephone relatively to the field of oscillations of the membrane, this being effected in such a manner that one pole is enclosed in the other, which has a tubular form, while the two poles can be moved vertically to and from the membrane by means of a suitable set screw. 1 claim.

11,426. "Improvements in or relating to indicating electric switches and current reversers." G. C. DYMOND. (A communication by A. B. Strowger and W. S. Strowger, both of Chicago.) Dated June 18th. One of the objects of this invention is to provide means by which the number of line wires required to operate electrical and other exchanges can be reduced to the least number possible, which means includes the introduction of oppositely polarised electro-magnets, which serve to operate the mechanism of said exchanges in combination with a means by which the positive and negative currents of electricity, respectively, from and to an electric battery are automatically reversed when being controlled to operate said magnets. 12 claims.

13,380. "Improved means of preventing injury to telegraph cables connected with lightships and floating stations." F. LE BRETON BEDWELL. Dated July 21st. The inventor employs an improved mooring swivel, the pin of which has a central hole through it. On the lower bow or ring of the swivel a boss is formed in line with the axis of the hollow pin, of such size in diameter that it will keep the shackles of the mooring chain apart. Through the centre of this boss a hole is bored in direct line with, and of similar size to that in the pin, through which the cable has a fair lead, thus avoiding the danger of being nipped by the shackles of the mooring chains. 3 claims.

13,920. "Improvements in methods of regulating electrically driven mechanism and apparatus for putting the same into operation." W. H. KNIGHT and W. B. POTTER. Dated July 30th. Consists in

regulating the power and speed of mechanism driven by two electric motors by placing the two motors in series for slow speed and changing them to multiple connection for higher speed by first short-circuiting one motor while its field magnet is still energised, and then disconnecting one terminal of such motor and reconnecting it to the corresponding terminal of the other motor, whereby the two motors will be in multiple with each other. 4 claims.

14,035. "An improvement in electric incandescent lamps." J. PINTER. Dated August 3rd. Mainly consists in surrounding the parts where the carbon filament meets the metal wires by a piece or lump of glass. 1 claim.

14,769. "Improvements in brushes for dynamos." W. P. THOMPSON. (A communication from H. H. Cherry, S. D. Younglove, L. House, and W. C. Raymond, all of America.) Dated August 16th. The object of the invention is chiefly to provide a dynamo brush so constructed as to ensure its thorough ventilation. 8 claims.

14,886. "Improvements in electric switches and cases for containing and protecting the same." A. WRIGHT. Dated August 17th. The object of this invention is to produce an electric switch in which the movement of the lever in one direction slightly past the centre will call into action a spring, or springs, to carry the shaft, on which the counter-block is secured, to its furthest point of rotation in that direction and to positively switch the current from one circuit to the other. The further object of this invention is to produce a case in which the switching mechanism may be contained and protected from injury by the weather. 6 claims.

15,059. "Improvements in portable electric incandescent lamps, and in battery cells and fittings therefor." H. C. GOVER. Dated August 20th. Relates to improvements in portable electric lamps, in which either a primary or a secondary battery is combined with an incandescent lamp and other necessary fittings, together forming a self-contained and movable lamp. 6 claims.

15,179. "Improvements in arm rests for telephone operators." J. R. BAILEY, and L. C. LINCOLN, and THE WOONSOCKET EDGE TOOL COMPANY. Dated August 23rd. Has for its objects to embody the features of vertical, lateral, and horizontal adjustment for the rest, and to adapt the same to be thrown up out of the way when not in use, the parts being strong, durable, and not liable to get out of order. 3 claims.

15,225. "Improvements in semi-incandescent electric lamps." C. A. J. H. SCHROEDER and H. E. R. SCHROEDER. Dated August 24th. Relates to a semi-incandescent lamp of the Werdermann type, in which the carbon is pressed upwards by being immersed in a tube of mercury. 6 claims.

15,238. "Improvements relating to telephonic switching apparatus." A. R. BENNETT. Dated August 24th. The inventor joins one of the conductors of all the flexible connecting cords to a common lead or to earth, and he provides, as described in 12,484, A.D. 1891, at every section of the switchboard in the exchange a metallic test tip or point which is joined electrically by means of a flexible connection to any suitable indicating device, such as a bell or telephone, or the like, and he joins all the said indicating devices to the common lead above mentioned or to earth.

15,469. "Improvements in signalling apparatus for telephones." G. E. HEYL. Dated August 29th. Relates to an improved signalling apparatus for telephones, by means of which a weaker or stronger current may be sent through the line, the weaker current being employed for giving the usual bell signal, and the stronger current for enabling the person wishing to transmit a message by telephone to operate an ink-writer or other electric recording apparatus, and thereby to produce in this apparatus letters or signs indicative of its name; in some cases my improved apparatus is constructed in such a manner, that any telegraphic message may be transmitted by means of the same. 13 claims.

15,477. "Improvements in the means for and method of melting metals and other materials by electricity." A. F. W. KREINSEN. Dated August 29th. According to these improvements, the fusion of the material is effected in electrically heated crucibles, or it may be primarily fused by being brought into contact with a carbon electrode through which a sufficient electric current is caused to pass. 5 claims.

15,691. "Improvements in electric air ships." C. DRILL. Dated September 1st. By the use of special devices, the balloon and car attached to same is drawn to the ground without allowing any of the gas to escape. 14 claims.

15,799. "An improvement in galvanic batteries." E. NUNAN and J. W. NELSON. Dated September 2nd. Claims:—1. The formation of a galvanic battery in the manner and by the ingredients or compounds described. 2. The manufacture and employment of a two-legged electrode of different heights, one leg being in direct contact with an exciting agent, and the other encased in a partial resisting medium, as described and substantially as shown in the drawings.

15,833. "Improvements in telegraphic apparatus." W. P. THOMPSON. (A communication by L. Dill, of Frankfort-on-the-Main.) Dated September 3rd. The improvements of this invention are designed to entirely dispense with the wheel-work, the feed motion being obtained by a local battery connected with the apparatus, and the said improvements also serve to print the characters as desired, either in the longitudinal direction of the strip of paper, or in the transverse direction. 6 claims.

15,864. "Improvements in electrical switches." C. W. ATKINSON. Dated September 3rd. Consists firstly in the mounting of the movable connecting piece of the switch upon the operating mechanism that it is in a sense not influenced as to its position on the contacts, except in the direction desired, and therefore forms a floating contact, and secondly, in the specific construction of a switch in a cheap and efficient form. 3 claims.

15,998. "Improvements in the manufacture of electric circuits and cables." A. V. NEWTON. (Communicated from abroad by J. A. Barrett, of New York.) Dated September 6th. By this invention an improved circuit is provided consisting of a single strand, the circuit being oblong, or of substantially flat form in cross section, so that a larger number of circuits may be packed in a given space than with circuits of other forms, and with the insulation between and about the conductors of the circuit so adjusted that the insulation between the conductors of the same circuit is always greater than that between conductors of adjacent circuits, when the circuits are grouped to form the cable, the insulation being such that it may readily be adjusted to secure the desired distribution in making the circuit. 21 claims.

16,371. "Improvements in electric locomotives." W. H. SOLEY, W. W. PERKINS, J. WOLSTENCROFT, W. O'NEILL, and W. H. YELLAND. Dated September 13th. The object of the invention is to provide an electric locomotive having traction wheels of substantially the same size, and differential driving mechanism between the motor and the front and rear axles, which will permit the car to run at a high or low rate of speed as desired, while the speed of the motor is maintained at a uniform rate. 3 claims.

16,434. "Improvements in the construction of electric light switches, cut-outs, ceiling plates, wall-connectors, lamp-holders, and the like." C. M. DORMAN and R. A. SMITH. Dated September 14th. Consists partly of an improved method of forming a screw thread in the covers of such articles, partly of an improved terminal for the attachment of the wires or cables, and partly of an improved method of making the contact arms in switches. 3 claims.

16,461. "Improvements in secondary batteries." W. MAIN. (Under International Convention.) Dated February 15th. Consists, in part, of improvements in connection with secondary batteries of that class covered by letters patent No. 4,303, of 1887, and 6,112, of 1889. 34 claims.

16,469. "Improved contact fittings for movable electric lamps." C. E. WEBBER. Dated September 14th. Relates to certain improved contact fittings for movable electric lamps, particularly for those in domestic use, which are placed on tables or other pieces of furniture, and the object is to provide a fitting which will admit of easy connection and disconnection of the standard or pedestal used to carry the electric lamp or lamps, and which will be available whether the table or other support is covered by a table cloth or not, and if so, without removing same, and without the necessity hitherto always existing of carrying the wires over the cloth or through specially prepared holes in the same. 2 claims.

17,222. "Improvements in or relating to electric metal working or welding." W. P. THOMPSON. (A communication by C. L. Coffin, of Detroit.) Dated September 27th. Claims: 1. The described mode of electrically filling a seam in a plate with molten metal, consisting in connecting said plate with one pole of a source of electricity, supporting over said seam a plate of metal with which said seam is to be filled at an angle with said first-named plate connecting said last named plate with the other pole of the electric generator, and forming a voltaic arc between said plates. 2. The described method of electrically welding sheets or plates of metal, consisting in connecting said plate with one pole of a source of electricity, supporting over said plate in line with the joint a plate of metal at an angle with said first-named plate, connecting said last named plate with the other pole of the generator, and forming a voltaic arc between said plates, whereby the joint is progressively heated and supplied with molten metal from the last named electrode plate.

17,226. "Improvements in the method of and apparatus for welding or heating metals electrically." W. P. THOMPSON. (A communication by C. L. Coffin, of Detroit.) Dated September 27th. Claims: 1. The described method of electrically welding the ends of a continuous piece of metal consisting in closing a gap in the secondary of a transformer or converter by the ends of the piece to be welded (the said piece of metal lying parallel at all points to said secondary), passing suitable currents through the primary of the transformer, and pressing the ends of the piece together when raised to a welding heat. 2. An apparatus for electrically welding continuous metal bands consisting of a converter having a broken secondary, and means for inserting the piece to be welded within the core of the transformer so as to complete said secondary, substantially as described.

17,227. "Improvements in or relating to electrically welding or heating metals." W. P. THOMPSON. (A communication by C. L. Coffin, of Detroit). Dated September 27th. Claim: The described method of heating metal consisting in subjecting the opposite sides of the metal simultaneously to the action of voltaic arcs alternated in position.

17,242. "Improvements in electro-medical appliances." P. A. NEWTON. (Communicated from abroad by S. Hetherington-Carruthers, of New South Wales.) Dated September 27th. This invention is for the purpose of utilising an induced current for electro-medical purposes, and consists essentially of three parts:—1, a single cell, or a battery, of any suitable design or construction:—2, of an induction or intensity coil:—3, of any suitable textile fabric into which strips or bands, consisting of any suitable number of metallic fibres or filaments that would act as electrical conductors, have been previously placed or woven. The fabric may be made into towels, belts, knee caps, corsets, stockings, bandages, sheets, or other articles that are brought into immediate contact with the flesh of the wearer or patient. 4 claims.